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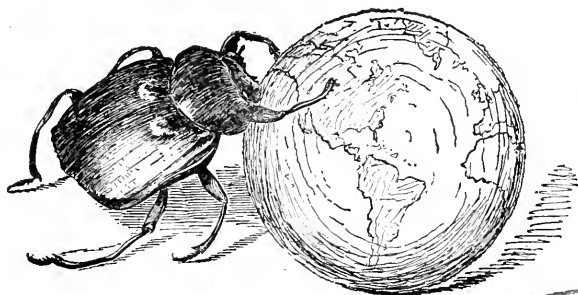
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Edited by CHARLES SCHAEFFER

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FOOD HABITS OF CORIXIDS.

BY H. B. HUNGERFORD,

ITHACA, N. Y.

In the literature dealing with Aquatic Hemiptera, we are informed that there are some ten or eleven families of the higher Heteroptera¹ that dwell in or upon the water, where they maintain themselves by preying upon other living forms. An examination of the external structure of the majority of them substantiates this view. For whether we examine the slender Hydrometra that stalks its prey upon the water, or the Naucorid that lies in wait in the tangled vegetation of the pool, we find a sharp beak, and, in the latter case, rapacious forelegs. These are the two extremes to be sure. The foreleg of Hydrometra is but slightly modified if at all, but the beak is sharp and the stylets, though flexible, are strongly and retrorsely barbed²; while the foreleg of the Naucorid is greatly modified into a most efficient grasping device (Plate II, figs. 3 and 6).

There is, however, one large family of water bugs whose external equipment is strikingly peculiar and whose front legs, if used for

¹ See Bibliography references (7), (8) and (9).

² Mr. J. R. De la Torre Bueno has reared these upon flies and like forms which he dropped upon the surface of the water. I have observed them catching larvæ and pupæ of mosquitoes as they were taking air at the surface film. And I have also watched them capture young members of their own species, small midges, and plant lice, but in none of these operations were the forelegs involved in the retention of the prey, the barbed stylets being able to retain even large and active wrigglers.

catching and holding prey, have developed along a line quite remote from the usual form. The forelegs possessed by the Mantids and the Notonectids alike are suited to withstand the struggle, but the spoon-shaped scoops of the forelegs of Corixids, fringed as they are with bristles, might present a sorry sight after an encounter with some struggling victim (Plate II, figs. 1, 4 and 5). Perhaps Dr. Kirkaldy³ had this point in mind when he wrote regarding the Corixids:

"Although not so specially adapted to our eyes for such a life, the Corixidæ have gained a more complete mastery over the problems of aquatic existence than their relatives, the Notonectidæ and Naucoridæ, if we may judge by the much greater number of their species."

As we shall see, their equipment is more nicely adapted to the lives they lead than we have ever supposed.

When we began a study of the food habits of the boatmen, aside from the generalization cited at the beginning of this paper, there was but one specific clue as to their food habits. Dr. Abbott noted some of the larger nymphs of *Ramphocorixa balanodis* (Abbott)¹ feeding on ostracods. Our studies were started in the fall, and one Corixid, after a prolonged fast, was induced to attack a blood worm.

Though the adult Corixids were early noted to spend much time apparently scraping the sediment from the dead oak leaves that were in the aquarium, it was not until spring that the nature of their feeding habits was definitely determined. This was revealed in a delightful way by the newly hatched Corixids, which were confined in petrie dishes with a little pond water, and some of the brownish deposits, so characteristic of the bottom of quiet pools. These little fellows could be observed for hours under the binocular and were not easily disturbed.

The method of food getting by boatmen in all stages has been observed many, many times, but the account would not differ greatly from my first observation, recorded in my notes as follows:

"Petrie dish A: It is my good fortune this morning to watch under the binocular one of these little corixid nymphs search out his breakfast. It is on a bit of oak leaf covered over with brown sedimentary

³ Canadian Entomologist, Vol. XL, No. 4, 1908.

⁴ Now *acuminata* Uhler.

material containing threads of *Zygnema*, diatoms, spores, euglenæ, etc. Amongst this material plows the little Corixid, leaving in its wake a ridge of sediment bounded upon either side by a furrow. The body is supported upon the long middle legs. These legs are broadly spread. The femora go out at right angles to the body, the tibia turn down at a wide angle, thus providing a biped support upon which *Corixa* swings from the horizontal to a position with the face nearly parallel to the surface of the leaf, and the caudal end of the body elevated. This support suits *Corixa*'s purpose, for it moves forward in feeding rather slowly considering the rapidity of its other movements. When an advance position is desired, first one leg is brought forward and then another, rather stiffly, like a boy on stilts. The arc of this swing enables it to bring the face against any mass of this loose material and working the forelegs rapidly it gathers double arm loads of material and passes it across its face from front to rear. Arm load after arm load passes by its face, appressed there by the flat rakes of its forelegs (Plate II, fig. 5). The buccal opening is on the cephalic surface of the beak and thus this machine, doubtless working like a colander, sends into the mouth bits of food material, and that which passes by is crowded on under the body between the middle legs and soon appears from beneath it partly due to the Corixid's advance and partly to the force of the material crowded after it.

The hind legs are all the while out at an angle to the body after the fashion of the parent and now and again strike forth in one or a whole series of rapid strokes that propel it forward not at all, but doubtless drive a current of water with its newer air supply across the body.

So intent is *Corixa* upon its work of embracing this food-containing material that it pays slight attention to the cyclops that scurry by—to the little grayish spotted ostracods that glide in and out of the way, or to a baby snail that comes close.

Beginning with the third instar, the Corixids evince more concern regarding their air supply, and spend less time in continuous feeding. The adults also are nervous feeders, gathering up a little in one place, then suddenly darting to another, with no apparent reason.

If one examines the head parts of a Corixid, it will be soon discovered that the stylets, when exerted, are directed forward out of the opening which lies on the cephalic side of the beak a trifle above

its tip (Plate II, figs. 2 and 5). These stylets are roundly notched on their outer side, as shown in the drawing and the opening is capable of some enlargement—facts which enable us to understand how some surprising bits of material come to be found in the digestive tract. (We have found oscillatoria 9/10 mm. long and bits of *Zygnema* filaments consisting of as many as seven cells.)

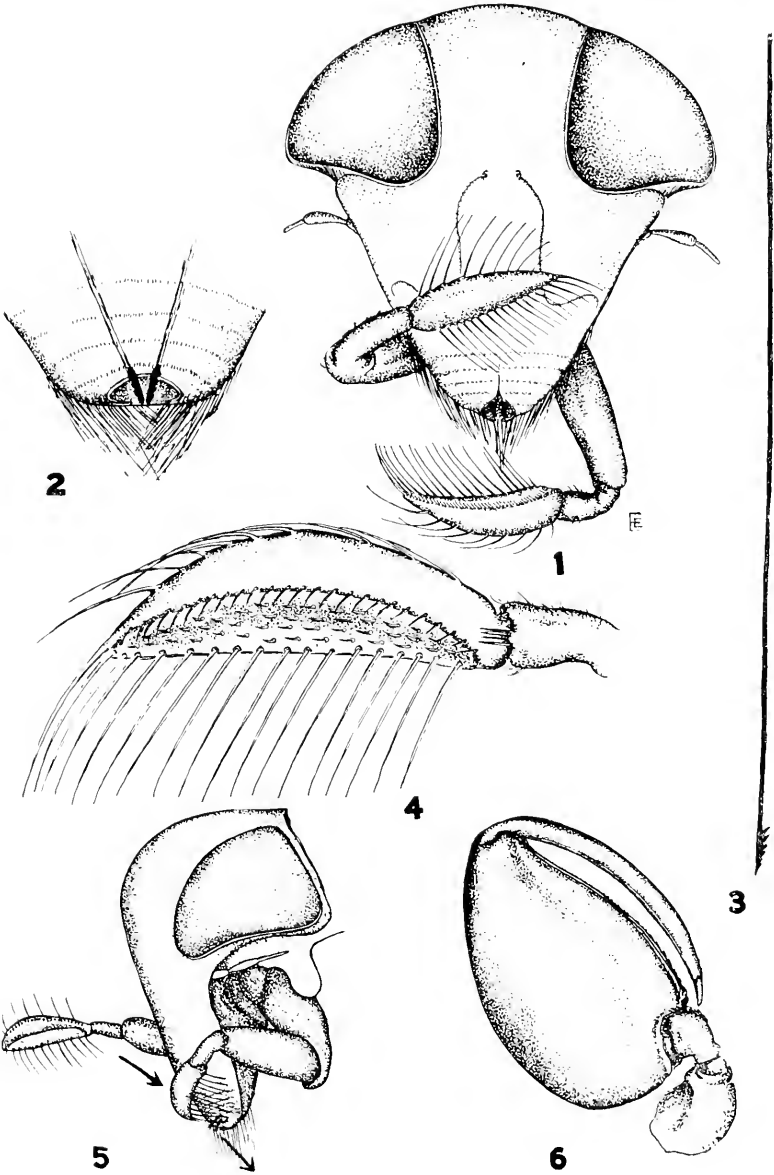
We have spent many delightful hours watching the boatmen in their natural surroundings and in the aquarium and feel safe in saying that the customary food of Corixids consist of such matter as is to be found in the brownish deposits on the bottom of the pool and upon the dead leaves that have lodged in its shallow waters. These deposits consist of tiny bits of organic matter, diatoms, desmids, oscillatoria, sometimes threads of live, more often dead filaments of *Zygnema*, *Euglenæ*, paramecium, *Chlamydomonas*, spores of various algæ and the cysts of *Euglenæ* and other unicellular plants and animals.

That these things form the daily fare of Corixids can be substantiated by any one who cares to examine the stomach contents of a few of them.¹ To be able to say just what, out of all the matter they take into their little bodies, nourishes them, is a more difficult matter, and involves feeding them on pure cultures. But for the purposes of this paper, it is enough to point out the source and nature of their food supply and call attention to the fact that here may be one reason for their dominance.

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¹ The reader might be interested to know that I have reared Corixids from egg to maturity in 11 cm. petrie dishes. As many as twelve have been reared in one petrie by giving them a few pipettes full of fresh sediment each day. In a few instances in the past have appeared accounts of Corixids feeding on animal organisms. After having watched them repeatedly strike out of their way, during their foraging, ostracods and similar organisms I am convinced the observations are exceptional or misinterpreted.



Corixa.

[In all the aquatic forms, both gymnoceratous and cryptoceratous (with the possible exception of the Corixidæ) the anterior legs are raptorial. In all the femora are dilated—in some moderately, in others enormously.]

5. KIRKALDY, G. W. Guide to the Study of British Waterbugs. Entomologist, 1899, p. 111.

(Corrects above statement by excepting Hydrometra.)

6. KUHLGATZ, THEODORE. Rhynchota in Brauer's Die Süßwasserfauna Deutschlands, 1909, heft 7.

(See page 87, "Nähren sich vom Aussaugen anderer kleiner Wassertiere, besonders Insecten. . .")

7. OSBORN, HERBERT. Phylogeny of Hemiptera. Proc. Ent. Soc. Washington, III, pp. 185-190.

(Considers Cryptocerata as highly specialized.)

8. PATTON, W. H. Notes on Phylogeny of Hemiptera. Ent. News, VII, 202.

(States that he believes the waterbugs are of high rank.)

PLATE I.

Fig. 1. Cephalic view of head and forelegs of a female Corixid. The left leg has been turned in a position to show the nature of the paler surface, which in the right leg is appressed to the face.

Fig. 2. The extremity of the beak of a Corixid from a specimen cleared in caustic potash. It shows two of the stylets and the nature of their tips. It also reveals the fact that they are strongly chitinized only for a short distance. They afford a remarkable contrast to the stylets of *Hydrometra*, which are exceedingly long and capable of being exerted beyond the tip of the beak a distance nearly as great as the length of the beak itself.

Fig. 3. The tip of a stylet of *Hydrometra* to show its equipment for retaining prey. These stylets when not exerted extend well back into the peculiarly long head of the bug. *Hydrometra* spears its prey and depends upon the effectiveness of its barbed stylets to hold and its poisonous salivary injections to subdue the victim.

Fig. 4. A view of the pala of the right foreleg of a female boatman. An efficient device for scooping up and bringing to the mouth the sedimentary material in the deposits on the bottom of the pool.

Fig. 5. Lateral view of the head and forelegs of a male Corixid, to illustrate the process of food gathering. The arrows indicate the direction of the food material. The stylets are shown exerted, one foreleg passing food material across the face and over the buccal opening, the other in the act of gathering material.

Fig. 6. The right foreleg of a Naucorid seen in ventral view. This presents the usual modification of the foreleg for grasping and is shown in contrast to the type of the foreleg of the boatmen, so long believed to be predaceous.

Note.—I am glad to acknowledge my indebtedness to Miss Ellen Edmonson, a student in the department, for figs. 1 and 4; the remaining figures are my own.

TWO NEW CICADAS FROM LOWER CALIFORNIA,
MEXICO.

BY WM. T. DAVIS,

NEW BRIGHTON, STATEN ISLAND, N. Y.

The descriptions here presented have been made possible through the kindness of Professor Myron H. Swenk, of the University of Nebraska, who has permitted me to examine a number of interesting species from the collection of that institution.

In the Transactions of the Maryland Academy of Science, 1892, p. 163, Prof. P. R. Uhler described *Tibicen blaisdelli* from the vicinity of San Diego, California. Distant later placed the species in his genus *Okanagana*, of which he designated *rimosa* Say as type.

In "A Preliminary List of the Hemiptera of San Diego County, California," Transactions of the San Diego Society of Natural History, Vol. 2, p. 47, October, 1914, Mr. E. P. Van Duzee described *Okanagana distanti* with varieties *truncata* and *pallida* as closely related to *blaisdelli*. The type locality for *distanti* and varieties is San Diego, Calif., and vicinity.

In "A Preliminary Review of the West Coast Cicadidæ," Journal N. Y. Ento. Society, Vol. XXIII, p. 31, March, 1915, Mr. Van Duzee proposed the genus *Clidophleps* to include the known species *blaisdelli* Uhler, and *distanti*, the latter being designated as type. In the original description of *blaisdelli* in 1892 Uhler pointed out the peculiar form of the radial and adjoining cells and stated that a new genus might be erected, the "elongation and expansion of these cells" suggesting a close relation with *Platypedia*.

The original description of *blaisdelli* contains the following: ". . . the radial cell large, wide, reaching beyond the middle of the wing-cover and its bent apex forming the base of three ulnar cells, the cell below the radial one [median] is narrow throughout one half of its length, and beyond this it is greatly expanded towards its triangular tip, the cell next below this [cubital] is shorter, but quite wide, with its inner vein strongly arched, and with a kind of triangular fuscous nodus bounding its outer end." In *C. distanti* as well as its varieties ". . . the greatly thickened and nodose transverse vein

at the apex of the clavus" is a prominent feature according to Van Duzee.

The following, while clearly a *Clidophleps*, lacks some of the prominent characters of the two species of the genus so far described.

***Clidophleps astigma* new species.**

Type, male, San Fernando, Lower California, Mexico, May, 1889 (W. E. Bryant). Collection, University of Nebraska.

Head as broad as the front margin of the pronotum; front considerably produced, much more so than in *distanti*. Median sulcus of the front well defined. Pronotum with the humeral angles rounded; the anterior angles also rounded and rather prominent. The opercula with the extremities rounded. Last ventral segment rounded and slightly emarginate at apex. Uncus when viewed in profile bent downward at extremity and deeply sinuated on the lower



Clidophleps astigma

surface of the apical half. Basal areolæ of the fore wings clear. Costa of the fore wings narrowly margined with brown, membranes orange. Hind wings with membranes lighter colored and clouded. The fore wings are proportionately narrower than in *distanti*, the costal margins are more evenly curved, the central portions are not so much bulged outward, or upward if the wings are expanded, and the "triangular fuscus nodus" at the outer end of the cubital cell is reduced to a mere thickened vein. Head black with the supra-antennal plates and triangular area behind the middle ocellus yellow. Beneath, the head is black margined with yellow on each side of the transverse rugæ. In some of the paratypes the median sulcus is yellowish. Pronotum narrowly margined with yellow and with a narrow yellow stripe about one millimeter in width extending from the front margins to the hind margin, on either side of which there is a large irregular brownish colored area clouded along the depressions. Mesonotum black with an irregular yellow spot near the base of each fore wing; the mesothoracic cross is yellowish, as are two narrow and curved spots near its front extremities. On either side between the cross

and the spot at base of wing there is an elongate spot in the type and paratypes not present in any specimens of *blaisdelli* or *distanti* so far examined, nor mentioned in the description of those species. The W-mark at the fore margin has but the outer lines present. Metanotum black, the hind margin and sides yellowish. Dorsum of the abdomen black with the hind margins of all of the segments edged with yellow. Beneath, the legs are yellow lined with black on the tarsi, tibiae and femora, the fore tibiae being nearly all black. Each abdominal segment is black centrally at base and yellowish on the posterior margin and sides, each yellow side area includes a clouded spot. The last ventral segment has the posterior half yellow and the valve is yellowish clouded centrally with fuscous.

MEASUREMENTS (IN MILLIMETERS).

	Male Type.
Length of body	21
Width of head across eyes	6
Expanse of fore wings	54
Greatest width of fore wing	8
Greatest width of operculum	1.5
Length of valve	3.5

In addition to the type, three other males collected at the same locality and at the same time have been examined. The smallest has an expanse of wings of 44 millimeters but otherwise closely resembles the type. The almost total obliteration of the stigma at the end of the cubital cell will serve to separate this species from the two others in the genus. It also has narrower fore wings and more prominent front than *distanti*, and the veins of both pairs of wings are not as stout and black as in *blaisdelli*. As San Fernando in Lower California, Mexico, is only a little over two hundred miles south of San Diego County, California, *C. astigma* will very likely be found within the limits of the United States.

The following additional records of specimens of *Clidophleps* in the author's collection or examined by him may be of interest.

C. blaisdelli Uhler.

San Diego Co., Calif., June 20, 1913. Mr. Van Duzee states that this specimen was collected at Alpine from the chaparral. It is figured on plate 2. fig. 1.

C. distanti Van Duzee.

San Diego Co., Calif., May 24, 1914, four males, July 22, 1914, female (E. P. Van Duzee).

C. *distanti* var. *truncata* Van Duzee.

San Diego Co., Calif., June 28, 1913, male cotype (Van Duzee); San Diego, Calif., June 27, 1915, male (W. S. Wright); San Diego, Calif., male.

C. *distanti* var. *pallida* Van Duzee.

San Diego Co., Calif., June 14, 1913, male cotype (Van Duzee); Sequoia Nat. Park, Calif., August 6, 1915, 1,700 ft. two males (J. C. Bradley).

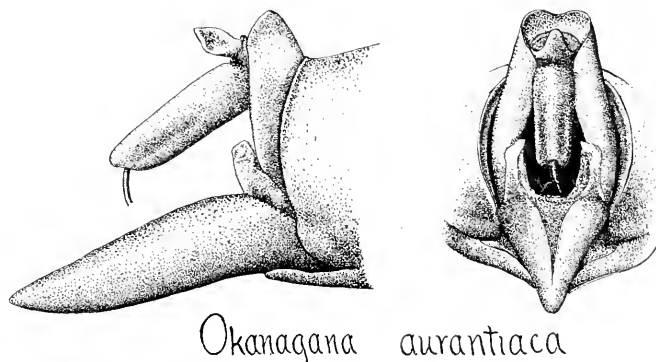
I am indebted to Mr. Van Duzee for identified specimens of his *C. distanti* and its varieties, also for the loan of the male *C. blaisdelli*.

One of the most noticeable species of *Okanagana* that we have seen is represented in the collection of the University of Nebraska by four individuals, three males and a female, all bearing the locality label "Lower California?" From its colors the species is probably an inhabitant of an arid or semi-arid region.

Okanagana aurantiaca new species.

Type male and allotype female from Lower California? Collection, University of Nebraska.

Head rather small and not quite as broad as the front margin of the pronotum; front moderately produced. Median sulcus of the front well defined. Pronotum with the humeral angles rounded and the anterior angles rather prominent. Opercula with the extremities rounded, especially on the outer side. Uncus when viewed in profile not hooked at the end; when viewed



from above tapering to the extremity. The last ventral segment in the type is rounded at the extremity, also in one of the paratypes, while in the other paratype, it is not so much rounded and is sinuated. In the allotype the last ventral segment is broadly and deeply notched. Basal areolæ of the fore

wings clear. The veins of both the fore and hind wings are orange in color except those of the marginal cells which are inconspicuously darkened; the membranes at the base of both pairs of wings are also orange colored and only slightly brighter colored than the veins. The head is orange both above and below, with a fuscous spot on the front and a broken black band extending between the eyes; the tip of the rostrum and the terminal joints of the antennæ are fuscous. Pronotum orange with four linear fuscous marks, on each side of the median groove anteriorly, and two dots centrally near the posterior margin. In one of the paratypes the two anterior streaks are wanting. Mesonotum orange with a central broken band of black extending on to the mesothoracic cross; anteriorly there are about three irregular clouded fuscous spots on each side of the central, blackened area, and near the base of each fore wing there is a black streak. Metanotum orange blackened near the base of each hind wing, and with a central black spot, a continuation of the dorsal band of the mesonotum. Dorsum of the abdomen orange with a median black spot on each segment, the spots gradually growing smaller toward the extremity of the body. Beneath orange with two inconspicuous black spots at the base of each wing, both the fore and hind pairs, also small and inconspicuous fuscous spots near the base of the legs. There is a dark cloud centrally at the base of the abdomen beneath, except in the allotype, which has the abdomen all orange. All of the legs are orange except the claws, which are fuscous.

MEASUREMENTS (IN MILLIMETERS).

	Male Type.	Female Allotype.
Length of body	23	23
Width of head across eyes	6	6
Expanse of fore wings	52	64
Greatest width of fore wing	9	10
Greatest width of operculum	2.5	
Length of valve	5	

A glance at this insect gives one the impression of an entirely orange-colored cicada with a black band between the eyes, and a conspicuous dorsal band of the same color extending from the hind margin of the pronotum to the end of the abdomen.

EXPLANATION OF PLATE 2.

- Fig. 1. *Clidophleps blaisdelli* Uhler.
 Fig. 2. *Clidophleps distant* var. *truncata* Van Duzee.
 Fig. 3. *Clidophleps astigma* Davis.
 Fig. 4. *Okanagana aurantiaca* Davis.



FIG. 1.



FIG. 2.



FIG. 3.



FIG. 4.

Cicadidæ.

NOTES ON THE LIFE-HISTORY OF SOME NORTH AMERICAN LAMPYRIDÆ.¹

BY FRANCIS X. WILLIAMS,
LOS BAÑOS, PHILIPPINE ISLANDS.

INTRODUCTION.

This paper represents the biological portion of two years' work at the Bussey Institution on several species of beetles of the subfamily Lampyrinæ or true fireflies. The portion dealing with the embryology, and the structure and development of the light-organs of two common species, *Photuris pennsylvanica* DeGeer and *Photinus consanguineus* Leconte, together with illustrations of these two fireflies and their early stages, has recently appeared in the Journal of Morphology. The observations on the life-histories were made throughout the year but especially during the summer both in the field and in the laboratory. For collecting Lampyrinæ and particularly their larvæ, a small electric flashlight was found to be indispensable.

I wish to thank all those who have helped me in my work and especially Dr. Wm. M. Wheeler for many helpful suggestions and criticisms.

PREVIOUS BIOLOGICAL WORK ON FIREFLIES.

Comparatively little work has been done on the life-history and habits of American fireflies. In Europe, where more is known of the Lampyridæ than in our own country, *Lampyris noctiluca* L. has furnished more data than any other species. The male of *noctiluca* is fully winged but only faintly luminous, the female, on the other hand, is apterous and larviform and glows brightly. Newport, whose work was done from 1830 to about 1842, furnished a good general account of the life-history of this glow-worm. Olivier (1911, etc.), Fabre (1913), and others have also contributed biological data, but the most recent publication is that of Vogel (1915), who gives data on the larva of *Lampyris noctiluca* in relation to its life-history, and an excellently illustrated description of the external anatomy, as well as

¹ Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University. No. 124.

the structure of the mouthparts, pharynx, gizzard, etc. Especially valuable is the portion relating to the operation of the mouth-parts in connection with the poisonous secretion which is emitted through the mandibular canal.

Among those who have contributed to the life-history of North American Lampyridæ, Barber (1905 and 1914), Mast (1912), and McDermott (1910-1912) are deserving of special mention.

Photinus consanguineus Lec.¹

This is a rather slender, quite depressed insect, with the head well retracted under the prothorax. The antennæ are eleven-jointed and moderately slender, and the eyes are larger in the male than in the female. The prothorax is rounded anteriorly and at the sides, and truncate behind, with the posterior angles rather acute, the disc is convex with the margins broad and thin. The elytra have rather narrow side margins and two or three subobsolete carinæ, the legs are rather short, with the femora and tibiæ rather compressed. The abdomen is depressed, and in the male, bears the light-organ on the sixth and seventh sternites, while in the female it occupies the greater part of the seventh sternite. The head is largely blackish, the thorax yellowish, with a broad black median bar on its posterior half and bordered on each side with pinkish. The elytra have the suture and side margins pale yellowish, the legs are brownish and the abdomen, except for the pale yellow luminous area and the pale segments beyond on the ventral side, is blackish. The elytra are granulate and rather densely pilose, while the antennæ and the legs have short, glossy brown pile. The beetle measures from 8 to 12.5 mm. in length.

During June and July, this firefly is very abundant about Boston, and in the evening may be seen flashing its yellowish light in the low moist meadows. The males are active though not rapid flyers, but the females, while provided with wings, are not taken in flight. It is evident that the light-organ (situated on the sixth and seventh sternites in the male and occupying the greater part of the seventh in the female) serves as a secondary sexual character, but it is difficult, if not impossible, to explain the purpose of the larval light-organ. The mating responses of fireflies have been studied by McDermott (1910-

¹ *Photinus consanguineus* Leconte; Proc. Phil. Acad. Nat. Sci., V, 335, 1851.

1912), and by Mast (1912), among others in this country. I can add but little to their observations. The males of *Photinus consanguineus* are on the wing shortly before 8.00 P. M., and a half hour later the flashing is at its height, while after 9.00 P. M., there is a decrease. The female crawls up some weed or grass stem and emits a single strong, diminishing flash in response to the three or four flashes at rather long intervals, of the male, which may be flying nearby or perched on an adjoining weed. I can do no better than to quote Mast (p. 267-268): "The luminous or photogenic tissue in the female as previously stated is confined to a small area on the ventral surface of the third segment from the end. Just before the female glows in response to the flash of light produced by a male she raises and twists the abdomen so as to direct the ventral surface, the source of light, toward the male. If the male is directly above she twists the abdomen nearly through 180 degrees, if to the right or left through 90 degrees, etc. Only when the male is directly below does the female glow without twisting the abdomen. These responses occur in the western Maryland species, almost invariably, and they are so striking that they cannot be readily overlooked." This species flashes but once in either sex. Further observations by McDermott show that different species of *Photinus* have a characteristic mode of flashing. In *Ph. consanguineus*, in the few instances under my observation, the male, in response to the female, would alight near the latter and search about excitedly, flashing in the meantime, and the female would respond in a rather feeble manner to the male, but a few inches away. Often considerable time elapsed before the male found his mate.

Neither sex was observed to eat anything, nor could the stomach contents of alcoholic specimens be determined. Bowles (1882), speaking of *Lampyrus noctiluca*, a European genus allied to *Photinus*, says: "The perfect insect is herbivorous and feeds only on the tender leaves of plants; but the larva is voracious in its habits, devouring snails, slugs and soft-bodied insects."

Ph. consanguineus oviposited readily in captivity, but the number of eggs laid by a single specimen was not ascertained. The eggs are deposited among fine grass roots or a short distance in the soil. The egg measures about 0.750 by 0.666 mm. It is dull creamy white, and smooth under a hand lens. A thin membrane with oil-like dots envelops the chorion. The egg is at first quite soft and often consid-

erably flattened against the surface to which it adheres by the viscosity of the outer membrane. Newport ('57), speaking of *Lampyris noctiluca*, states that at the moment of laying, the egg is covered with a very adhesive sticky matter. Later the egg becomes firmer and loses much of this stickiness. The laboratory period of incubation was from about thirteen to fifteen days, a large batch of larvæ hatching about July 24 in 1913. According to Newport, the egg state of *Lampyris noctiluca* is about nineteen days. Vogel ('15) says that oviposition of the same species usually occupies two or three days and incubation twenty-seven to thirty, thirty-six, and even forty-seven days, according to the temperature of the summer. *Photinus* larvæ which are ready to emerge have conspicuously black eyes and brown mouth-parts.

When freshly hatched the larva is about 2.35 mm. long, and whitish, except for the blackish eyes and brown mouth-parts. Soon it becomes slaty gray with the head largely brownish. Its length, exclusive of the retractile head, a few days later is 2.5 mm., and the width at the second thoracic segment is 0.6 mm. The form is oblong-elongate, broadest at the thorax and thence tapering gradually toward the caudal extremity. The body is depressed, and rounded-carinate mesially. There is also a subdorsal carina on the thorax, which is less distinct on the abdomen and which marks the course of a pale stripe. The head is about half as wide as the prothorax and nearly or quite as long as the latter; the antennæ are three-jointed, the third joint is strongly chitinized and bears one globular and one cylindrical sense-organ distally. The mandibles are arcuate, with a finely pointed tip and a projecting præapical internal ridge. The legs are slender and spinose, and under high magnification the body appears roughly granulate. The single pair of prolegs is strongly multifurcate, and the many filaments are thickly armed with rows of ventral hooks, which occur also along the base of the furcation. The larva has well-developed light-organs in the form of two small lenticular structures in the ventral portion of the eighth abdominal segment. These glow with a yellowish light.

The duration of the first instar of *Lampyris noctiluca* is about fifteen days according to Newport ('57). The first moult occurs nineteen days after hatching. Under artificial conditions I found the young *Photinus* larvæ quite delicate, and I was able to carry but few

over into the third instar. When ready for the first moult they are about 3 mm. long. I kept these insects in a jar of moist earth and fed them flies which were cut up so that they could be devoured more easily. Several larvæ would gather about a fly and bore their way into it till their heads and a portion of the prothorax were hidden from view. They remained thus for some time, so that when a day later I examined the larvæ, I found them all dead from suffocation. Like *Photuris*, they pass the greater part of two years as larvæ, and like the former, the same brood is sometimes characterized by the unequal growth of some of its individuals, so that there are larvæ which probably require less and others more than two seasons to produce adults. No first-year larvæ were taken in the field. Newport, in rearing *Lampyris noctiluca*, noticed different rates of growth among the larvæ under apparently the same conditions. He adds that they may not all mature the same year, for as much as one year and nine months may elapse before full growth is attained.

The full-grown larva is about 13 mm. long, exclusive of the head, and with the head extruded, 14.5 mm. The head is depressed, subcylindrical, somewhat longer than wide, and about half as wide as the prothorax. The antennæ are three-jointed, with two terminal sense-organs. The body is slender and depressed and a little wider at the middle. The tergites are heavily chitinized and coarsely punctate and rugose, while on each side of the dorsal median line is a rather indistinct carina, most evident on the thorax and tending to disappear posteriorly. The legs are slender and the prolegs very much divided into dichotomously branching filaments. The dorsum is shining black, the ventral sclerites are smoky brown and the membrane is dirty whitish, with the exception of the venter of the thorax as well as the sides above the lateral line, where there is often a decided suffusion of pinkish. The legs have the chitinous portion testaceous. The head is black and the mandibles reddish brown. The body has rather sparse yellowish-brown hair. The adipose tissue gives the anterior part of the body a pinkish tinge. The larvæ of *Ph. pyralis* (Rep. N. J. State Mus., p. 298, 1909) and *Ph. modestus* (Kellogg's American Insects, p. 269) much resemble that of *consanguineus*.

It seems evident that a larva of the form of *Photinus* is not so well fitted to lead an active life above ground as that of *Photuris*. As a matter of fact, it is much more subterranean in its habits and

therefore less frequently seen and taken. It also inhabits damper situations. Larvæ were found in the fall, winter and spring of the year, but most abundantly in the fall. Upwards of one hundred were secured, mostly from September 8 to October 5, 1913. On March 20, 1915, a few hibernating individuals were taken in a moist field, where they lay buried a few inches in the soil. They occurred in a small hummock which remained unfrozen. Active specimens were found on May 11, 1914. On warm summer nights as many as fifty could be taken in two hours. Some of these larvæ were a little off the ground, crawling along blades of grass, while others were creeping about the damp soil. They occurred most plentifully in the earth-choked channel of Bussey Brook at Forest Hills, Boston. In May, 1914, the low meadow, where I procured larvæ the preceding year, in many places stood an inch or more under water, which must have forced many of the insects out of the soil, for some were found a short way up stems while a small hummock yielded others.¹ The larvæ are more or less gregarious, at least during the later stages, for they gathered together in captivity, and were taken singly or more commonly in small groups under wood or other debris in their habitat, while another species of the same genus was found in some numbers under a sheltered piece of decayed wood. It would seem that their life is largely subterranean, and that they come to the surface only under more favorable conditions or during excessive moisture. In the laboratory large larvæ thrive with very little care in a jar of moist earth. At long intervals they were fed with earthworms which they paralyzed after the manner of *Photuris*. But they were by no means as voracious as the latter.

The pupal stage is quite brief. Pupating larvæ lose their bright

¹ In this connection it is interesting to note that Annandale, '00 and '04, twice found an aquatic lampyrid larva in lower Siam, and once in the suburbs of Calcutta. In the case of the Siamese specimens, the luminous organs were two small oval patches on the ventral surface of the last abdominal segment. As in other lampyrid larvæ the light shone steadily, though it was of a brilliant blue color. Many fireflies were flying over the marsh where Annandale took some of the larvæ. The latter he found clinging dorsal surface downwards to floating fronds of a small cryptogam. They ceased to shine on being taken out of the water, but the luminescence was resumed upon immersion in the liquid. No special respiratory organs nor air-silvered areas were found. He did not rear the larva to maturity.

color, shorten up a little and assume an arcuate position. The skin splits down the anterior part of the back and gradually liberates the pupa. The latter is formed under the soil.

The pupa, straightened out, measures about 11 mm., and in an arcuate position, 8 mm. It is depressed subcylindrical, with the appendages rather short and the lateral tergites only slightly drawn out and hardly reflexed. It bears, especially along the edges of the segments, some short and quite sparse hairs. The general color is yellowish white with a considerable suffusion of pinkish, especially along the abdomen. It is much less active than the pupa of *Photuris*, and, unlike the latter, never has a general effulgence. The larval light-organs shine steadily during the pupal life but are somewhat smaller and are rather more evident during the earlier than in the later pupæ, where the cuticula is much pigmented. By the time that the perfect insect is freed there is usually little or no luminescence in the larval organ.¹ Laboratory specimens which pupated during the winter were nearly all females.

***Photinus scintillans* Say.²**

This species occurs more rarely in the neighborhood of Boston than *consanguineus*, and is found on drier, higher ground, often associated, though to its own detriment, with *Photuris pennsylvanica*. Besides differing from its congener in its smaller size and more slender legs, as well as paler color, the male may also be distinguished by the fact that it (as well as the female) emits but a single, rather long flash to the three or four flashes of the male *consanguineus*. The female seems incapable of flight, and specimens are often met with having the abdomen protruding far beyond the elytra. The semi-gregarious larvæ are paler and more suffused with pinkish than *consanguineus* larvæ. A few of the larvæ were found upon the surface of the ground, and several large ones, superficially buried in the light soil, were taken in the evening.

***Ellychnia corrusca* Linn.³**

¹ In some cases at least, there is a rather brief period in the pupal stage during which neither the larval nor the adult photogenic organs glow. Such a case was observed on December 14, 1913. A pupa, apparently less than a day from hatching, could not by rough handling, jarring, etc., be induced to give any light whatsoever, though the adult organ was plainly visible.

² *Photinus scintillans* Say, Journ. Phil. Acad. Nat. Sci., V, p. 163, 1825.

³ *Ellychnia corrusca* Linn., Syst. Nat., Ed. XII, 644, 1785.

This is a very common firefly, a rather broad flat species, with a small retractile head, slaty black elytra and a pinkish stripe on each side of the disk of the thorax. It belongs to the *Photinus* group, and like the members of that genus, is capable of giving forth a viscous milky exudation and of clinging tenaciously to one's fingers. But it differs rather widely in its habits from *Photinus*, as will be seen from the following.

Ellychnia corrusca is most conspicuous in spring, appearing on tree trunks in New England, as early as April, and may be met with when autumn is merging into winter. Like the smaller variety *autumnalis*, it hibernates in the adult state, seeking refuge from the cold, beneath stones, in decaying logs, under tree burlapping, and beneath the looser moss about the base of tree-trunks where at times it congregates in considerable numbers. It is a decidedly hardy insect and, given the proper condition, a very large per cent. of the autumn individual seems to hibernate successfully. I confined 18 specimens (♂ and ♀) in a small brass box filled with moss and provided with a screen cover, and in late November placed it outside a window with north exposure where it remained until the middle of April. The box was brought in from time to time, slightly warmed and the beetles examined. Not all the *Ellychnia* were thus brought out of their torpor during these brief spells, but the activated beetles were very thirsty and drank eagerly from the moss which I had moistened. Of these 18 beetles exposed to temperatures that fell more than once below zero Fahrenheit, 16 were alive and healthy at the end of April. Mating takes place when the beetles are well out of hibernation. The earliest record I have in captive specimens is May 7, 1916. This pair, with other beetles, were previously given banana peel, the soft inner portions of which they consumed to some extent. As adults they are probably purely phytophagous.

The female oviposits readily in captivity. The egg is practically spherical, creamy white, and like that of *Photinus*, provided with a viscid outer membrane. It is faintly luminous for a time at least. The young larva much resembles the *Photinus* larva, though it is possibly a little broader. I was unable to rear it beyond the first moult. There are two luminous points on the eighth sternite, but these are not so pronounced as in young *Photinus* and *Photuris*, and in the same individual are sometimes fainter on one side than on the

other or they may not always be visible. I know nothing of the later larval stages or of the pupa.

The adult beetle is commonly regarded as non-luminous, and indeed this seems to hold true of the greater number of individuals. One evening while I was examining a jar containing a number of them, a single male was observed to bear a pair of faint yellowish lights, hardly to be perceived beyond an arm's length, on the eighth abdominal sternite, *i. e.*, in the very same position and segment as the larval lights. The glow was steady and sustained. This male was the only specimen which shone (or could shine) of its own accord, but by rough handling I was able to induce four other specimens to produce a very faint and evanescent glow. It seems probable that the organs are almost non-functional or vestigial and represent those of the larva. In the adult the chitin beneath, *i. e.*, ventral to the light-organs, instead of being transparent, is strongly pigmented.

Lucidota atra Fab.¹

This, like the preceding species, is diurnal, and in early summer may be seen clinging to herbage or in slow flight. It is a delicate, rather broad, depressed insect, 8–11 mm. long, with the antennal joints broadly flattened. The general color is black with the lateral edges of the prothorax broadly pinkish and yellowish. I found this insect abundant at Melrose Highlands, Mass. It is luminous in all its stages, although sometimes when freshly emerged it does not glow strongly as an adult insect.

The dull whitish eggs are subspherical and hardly differ from those of *Photinus*. The larva also is rather similar, but differs in being slightly more flattened above, and in the more angulate tergites which are dilute or grayish black instead of shining black. The larva of *Lucidota* is rather more suffused with pinkish but may be most readily separated from *Photinus* in having the lateral edges of the last two abdominal tergites very broadly whitish carneous. This pattern, situated as it is on the luminous segment, permits the brilliant yellowish green light on the eighth abdominal segment to shine dorsally as well as ventrally. The light is readily controlled and may not be used for a long period even though the insect be roughly handled. Larvæ in confinement often flash out quite suddenly if dis-

¹ *Lucidota atra* Fab., Ent. Syst., I, 101, 1798.

turbed and this is striking when they are in some numbers. Such sudden effulgence subsides rather gradually. Only half-grown to full-sized larvæ were found. These were often taken gregariously in the fall, winter and early spring in moist earth and rubbish, decaying stumps and under stones. The pupa, in conformity with the adult insect, has the abdominal segments drawn out posteriorly, both latero-dorsally and latero-ventrally. With the exception of the dull glassy head, appendages and tip of the abdomen, it is of a delicate roseate color. It is very active at this stage. Pupæ may not shine at all times and when shining may do so with varying intensity. In one case the luminous points appeared to be on both the eighth and ninth segments but more intense on the latter. In addition, some of the pupæ when disturbed gave forth a diffuse body glow. This recalls the glow of the *Photuris* pupa. Freshly hatched adults of both sexes shone better than older specimens, though neither did so at all times. A freshly emerged female on being handled emitted a diffuse yellowish-green light, the whole abdomen and at least the clearer lateral pieces of the prothorax being involved. The light seems to be under rather slow control and suggests that the adult may be partly nocturnal. The insect hibernates in the larval stage.

Pyractomena sp.

During the afternoon of April 19, 1916, while engaged in field work for the Gypsy Moth Laboratory of the Bureau of Entomology, I took this large and somewhat remarkable lampyrid larva at Hanson, Plymouth Co., Mass., as it was ascending the trunk of a large white oak (*Quercus alba*), at a height of four or five feet. This tree, with numerous others, formed a grove in a low, rather moist area.

The length of the larva, exclusive of the head, is 22 mm. The head is very small in proportion to the size of the body, for while decidedly elongate, its very narrow and nearly cylindrical form gives it the appearance of a dark, shining rod or tube. It is furnished with a pair of sharp-pointed, sickle-like mandibles which are somewhat upcurved at their distal end. The body is rather flattened fusiform but more narrowed posteriorly. The prothorax is by far the longest of the segments, being as long as or longer than wide and drawn out and narrowed anteriorly into a sort of neck. The thoracic legs are long and slender and strongly clawed. The rather indurate

tergites have their posterior lateral angles somewhat pointed and drawn out. The pleuræ and venter are partly membranous. The last abdominal segment is provided with a highly developed pair of fleshy, retractile and multifid prolegs. The tergites are variegated wood-brown, with a dark streak bordering the paler median line. Ventrally it is more pinkish. The insect bears some resemblance to a slender larva of *Photuris* and is undoubtedly predaceous and to a degree a climbing insect. The elongate, almost minute head, which tortoise-like, can be retracted far out of sight into the prothorax, would appear well fitted for exploring crannies in the bark, etc., for prey, while the long thoracic and much divided anal prolegs facilitate its scansorial habits.

I kept the larva in a tumbler partly filled with loamy soil, which, having previously contained a lepidopterous larva, had the sides more or less spun over with silk. Towards the first of May, the *Pyrractomena* had crawled up near the top of the tumbler and evidently by means of an anal secretion or a dried-up liquid of some sort had firmly suspended itself, venter towards the glass, by the tail. Its head was retracted (the pupating *Photuris* larva has the head extruded) and the two ventral lights on the eighth abdominal segment were often visible, and frequently most of the membranous portion of the body facing the glass showed a delicate effulgence. When I disturbed it the effulgence would brighten up considerably and so would the two tail lights. After having remained suspended in this quiescent stage for the matter of a week it transformed into a large pupa, the larval skin splitting laterally or ventrally and not dorsally, as with pupating Lepidoptera, and remaining shrivelled and attached to the posterior portion of the abdomen. The remarkable thing about this pupa, apart from its being suspended, is its darkly pigmented condition, which strongly suggests that it is always formed above ground and in a situation exposed to light.

The pupa is moderately stout and only slightly arcuate; the pronotum is long, and the tergites have their lateral posterior edges somewhat reflexed and pointed, making it appear rather spinous. The pronotum bears a yellowish white median line, which is bordered by a wider blackish stripe, beyond which is a wide yellowish-white edge. The remaining tergites as in the dorsum of *Photinus* larvæ are shining black and have a rather wide, dull yellowish-white median line while

ventro-lateral to the tergites there is much pink. The leg- and wing-cases are blackish. The abdomen in its softer portions is dull yellow and pink and has a brown sublateral stripe.

The comparatively long duration of the prepupal stage may partly account for the dark color of the pupa.

Judging from the single specimen I have observed this *Pyractonema* must differ rather widely in its habits from *P. lucifera* (see Wenzel, 1896) which lives in salt marsh meadows among snails.

***Photuris pennsylvanica* DeGeer.¹**

The adult beetle is elongate and rather flattened, the head is somewhat retracted under the prothorax, the antennæ eleven jointed, slender and tapering, and the eyes large. The thorax has the disc convex, with broad thin margins, and is rounded anteriorly and along the sides and subtruncate posteriorly. The legs are slender, the outer tarsal claw is bifid; the elytra are rather acute at the tip and extend well beyond the extremity of the abdomen. The general color of the head is dull yellow, with a black area on the posterior part of the vertex. The pronotum is dull yellow with the disc red and a median black stripe, while the rest of the thorax is very dark brown. The legs are paler at the base of the joints and at the apex of the femora, while the elytra are brown or piceous, with the suture, side margins, and a narrow tapering stripe on the disc, pale brownish. The abdomen is blackish brown with the posterior border of the fifth and all of the remaining sternites, yellowish. The luminous organs are yellowish and are situated on the sixth and seventh sternites. They are larger in the male. The body is clothed with fairly abundant yellowish pile, which is darker on the legs and most conspicuous dorsally. The pronotum and the elytra are densely and rather coarsely punctate. The length varies from 11 to 15 mm.

This is the largest and commonest of the brilliant New England fireflies, and from early June till the end of July, or the first week of August, both sexes may be seen along the borders of woodlands, flashing their yellowish-green light. The habitat of this species is therefore unlike that of the abundant *Photinus consanguineus*, which frequents low moist meadows. While it is true that *Photinus scintillans* flies with *Photuris* in this locality, owing largely perhaps to

¹ *Photuris pennsylvanica* DeGeer, Mem. Hist. des Ins., IV, 1768, 52.

the voracious appetite of *Photuris*, it does not flourish alongside its larger neighbor. Only a few *Photuris* were found in the *Photinus consanguineus* locality. As in other Lampyridæ, *Photuris* has more or less well-defined centers of distribution, areas fairly scintillating with their lights, which elsewhere are more scattered or absent. These places, where on favorable evenings the larvæ can be found in abundance, are evidently the ones in which they pass their early stages.

Both sexes of *Photuris* fly readily and rather high, but the males are more often seen on the wing than the somewhat terrestrial females. In July, the flight begins from a little before to a little after 8:00 P. M., and most of the males have settled by 9:00 P. M. While there is considerable uniformity as regards the number of flashes emitted by these insects, exceptions are common. As a rule, the males flash three or four times to a period, and the last flash is usually the least intense. Each flash is of about a second's duration, and separated from the next by considerably less. Some flash twice, another will give six very rapid flashes, but the number seems constant for each specimen. It was estimated that when in flight, the males flash for every fifteen feet traversed. They may scintillate in this manner when resting on trees or weeds. The flight of the female is more rapid and direct than that of the male, and her flashes are less intense and somewhat more variable. While on the wing she was observed emitting a dim though steady light. When alighted she flashes once or several times. In the latter case the intervals are longer than in the male.

While there seems to be little doubt that the light emissions play an important part in bringing the two sexes together, it seems equally clear that by itself, this function is less necessary in *Photuris pennsylvanica* than in the various species of *Photinus* studied by different observers. No exchange of light flashes was made out with certainty in the case of *Photuris*, and none occurred during copula. The female while shining does not necessarily assume a vertical position, as do *Photinus* and some of the European species, nor does she curve up the tip of the abdomen as in the latter. In the evening the females were usually resting in a more or less horizontal position, upon some bush or weed, or upon the ground, and the brilliant flash shone appreciably through the elytra. The photini were much less active than

the photuri, and were able to cling firmly to weeds, etc. The latter are very nimble runners and restless insects, so that the sexes should readily find one another.

When captured or roughly handled *Photuris* frequently exudes a pale honey yellow fluid from between the last coxal joints; this "blood" likewise exudes when the elytra are cut. In *Photinus*, *Ellychnia* and *Lucidota* the fluid is whitish and more viscous and flows even where the elytra may be flexed. The exudation is probably protective. The female oviposits for several nights and requires an abundance of food for her sustenance and for the development of the eggs which are in several stages of growth in her ovaries. Her appetite, to say nothing of cannibalism, is worthy of note. The male, on the other hand, seems to be a sparing eater. On several occasions a female was discovered perched upon some convenient stem, leaf, or upon the ground, devouring a male *Photinus scintillans*. One evening six females were disturbed at such meals. The fact that the victims were always males, though the females were nearly as abundant in this locality; and that the feeders were invariably females, strongly suggests that the weak *Photinus* males were drawn to their untimely ends by the lure of the greenish-yellow light of the female *Photuris*. When bottled up with *Photinus* they would readily devour the latter, despite its active exudations. When confined in the laboratory, a female would frequently overcome and devour a male of her own species, less often she would attack one of her own sex and cling tenaciously to her actively running prey. The males would not feed in captivity.

Oviposition was not observed in the field and was seen but once in the laboratory. The female thrusts her long ovipositor a few millimeters into the soil to lay the sticky, pale yellowish egg. Eggs laid in the laboratory, or better, by specimens confined in shady places out-of-doors, were deposited in the soil or among the roots of grass, either singly or in small groups. The egg, while not constant in size, averages about 0.784 by 0.677 mm. Its pale yellow color serves to distinguish it from the whitish egg of *Photinus* and *Ellychnia*. Under a hand lens it is polished, under a high magnification it has a finely dotted appearance owing to the presence of a thin membrane which contains oil-like globules and gives it the adhesive properties. When first laid the egg is soft and often more or less flat-

tened against an object, later it grows and rounds up somewhat and develops a firm and brittle shell. Long ago Newport (On the Natural History of the Glowworm, 1857) noticed the growth of the laid eggs and found them to be effulgent. Seaman (1891) says: "The eggs of the Lampyridæ and Pyrophori may be dried to their utmost without losing their photogenic property." Dubois (1898) adds that the eggs of *Pyrophorus noctiluca*, the large luminous Elaterid of the neotropical regions, shine when unfertilized, and even while in the ovarian tubes. He states that they have great affinity for moisture and will even glow when placed near a green blade of grass. Mr. H. S. Barber writes me (June, 1914) concerning *Phengodes laticollis* that "luminosity develops in the egg before hatching." The eggs of *Photuris pennsylvanica* certainly glow when deposited, and till they are from two to four days old, and therefore probably throughout their life, but the effulgence is often so faint that it can be perceived only by careful and protracted scrutiny in total darkness. In July, 1914, I squeezed several eggs out of the ovary of a living *Photuris*, and placing these in water, carefully examined them in the darkness. But they were not found to shine and so they were crushed and placed in hydrogen peroxide, when at least one egg emitted a faint luminescence.

In the laboratory eggs of *Photuris* hatched in about fifteen to eighteen days, into peculiar, very active, somewhat turtle-shaped larvæ about 2.20 mm. long. At first whitish, except for the blackish eyes and pale yellowish-brown of the feet, mouth-parts and antennæ, the larva darkens in the course of a day or two and becomes slaty gray with the head largely brownish. The length of the body is now about 2.50 mm., including the extended head 2.70 mm., its width at the third segment 1 mm. The head is depressed cylindrical, a little more than twice as long as wide and hardly one third the width of the prothorax. The eyes are simple and rather large, the antennæ short, tapering and three-jointed, the first joint is membranous and the third bears a cylindrical sense-organ distally and a lobed process before the end. The jaws are stout, arcuate and notched before the tip. The body is oblong oval, tapering more caudally, with the sides above depressed, forming a rather prominent median ridge; the prothorax is about as long as the meso- and metathorax combined, the latter two are each longer than any of the abdominal segments with the possible

exception of the ninth; the abdominal segments particularly, have the sides drawn out and curved posteriorly and armed at their apices with long strong spines; spines also occur sparingly on the dorsum, and smaller ones are scattered over the body, which is finely and irregularly granulated. The legs are slender and spinose, the tarsal claws simple though spined basally. The prolegs, of which there is but a single anal pair, have each side subdivided into six slender furcate processes and an inner shorter and stouter furcate process. All these sixteen processes are armed with rows of recurved hooks. The prolegs are less divided than in *Photinus*, and can be extended fanwise to serve both as an organ of propulsion and of adhesion, the tiny hooklets giving the insect a firm hold. The abdominal prolegs of beetle larvæ have been much studied by Brass (1914). He terms the organ, which is a development of the tenth abdominal segment, the seventh foot, and says that it finds its highest modification in the lampyrid *Luciola italica*, which has the proleg dichotomously branched into one hundred and twenty filaments. Brass suggests that it owes its development to the unsupported weight and extent of the abdomen. When fully expanded the soft fleshy foot covers a large area, and while not in use is protected by being completely withdrawn into the body cavity.

Photuris pennsylvanica uses its prolegs extensively in climbing weeds, and also employs them to brace itself, though often ineffectually, against the pull of its struggling prey. Occasionally it will curve the end of the abdomen over its back and use the finely divided seventh foot as a broom with which to clean its dorsum. This has also been observed in some European Lampyridæ, by Targioni Tozzetti (1865), Berlese (1909), Fabre (1913), etc. Species like *Lampyris noctiluca* that feed upon snails, thus wipe off the slime which has soiled them.

The larva of *Photuris* is capable of enduring considerable drought and of surviving for some time without food. Specimens which hatched about July 27, 1913, were offered cut-up insects, chiefly flies, which they devoured in the evening or in artificial darkness, hiding during the day in crannies and under lumps of earth. In feeding, they congregate about their food in some numbers and inserting their small extrusible heads into the victim soon convert it into a mere shell.

From August 8 to 10, approximately, most larvæ of this brood had passed into the second instar, having undergone one ecdysis. As upon hatching, they are soft and whitish for some hours, and measure about 5 mm. in total length. By August 20, many were in the third instar and 7 to 8 mm. long. The color is now quite dark, with the pale tergal markings conspicuous. The development of the brood as a whole becomes less and less uniform so that we meet with larvæ of the same age but varying considerably in size. I lost count of the instars beyond the fourth, after which there must have been three or more ecdyses. Some of my second-year larvæ moulted in the laboratory during winter. It is certain that the insect requires the greater part of two years to reach the adult stage, and it is not improbable that in some cases a longer period is necessary. The full-grown larva is from about 16 to 18 mm. long, being nearly three times as long as wide. The head is subcylindrical and about one third as wide as the prothorax; the antennæ are three-jointed, the first joint being membranous, the second partly so, and the third with a terminal and subterminal sense-organ; the mandibles are much stouter and blunter than in *Photinus*, but like the latter they are arcuate and also notched below the apex. The body is much depressed, otherwise it is fusiform, being widest a little above the middle; the prothorax is the longest segment and shaped much as in the adult; the abdominal tergites are curved posteriorly, especially the caudal ones. The legs are rather spinose. The head is largely polished black, the mouth-parts brownish, the dorsal part of the body dull brownish, sometimes quite dark, and having subdorsal yellowish-white stripes of irregular nature disposed as follows: a large one from the anterior border of the prothorax, a smaller one from its posterior edge; these are more faintly repeated on the meso- and metathorax; on the abdomen there is a pair of more or less broken inbowed stripes, becoming obsolete posteriorly, and a similar blotch near the lateral edge of each tergite. The dorsum is more or less irregularly dotted, in deep punctations, with blackish, which serves to darken the color as a whole; blackish spots are grouped inside the pale abdominal lunules, and a more or less broad arcuate line cuts into the subdorsal markings from within. On the ventral surface the color is dirty yellowish white except for some latero-ventral blotches of brown, which however are absent on sternites seven and eight and a part of nine.

The legs are pale wood brown, darker apically. The body is quite rugose, with spines along the margins and on the legs.

Throughout the summer and fall, when the days are still warm, these peculiar testudiform larvæ can be taken in goodly numbers creeping over the ground, near edges of brooks, under brushwood, and even several inches up plant stems. Most of them prove to be larvæ in the second year of their growth. Specimens in the second, third and fourth moults are less commonly seen, but all shine brightly and steadily from two little yellowish-green points on the eighth abdominal sternite. When a light is brought near them they hasten away, and when touched on the back have a habit of flattening themselves.

The feeding habits of American lampyrids are more imperfectly known than those of Europe, where Fabre, Newport and others have studied the natural history of *Lampyris noctiluca*. As a larva, this insect feeds upon *Helix nemoralis*, *aspersa*, and probably other snails which it cautiously bites, injecting a poisonous deliquescing fluid into its prey at the same time. The mollusc is rendered inert by several of these tweaks and can then be devoured at leisure. Fabre (1913) speaks of the remarkable case of the Algerian beetle, *Drilus maroccanus*, allid to the glow-worm, which fixes itself to the surface of the snail-shell and there awaits, for days if it needs be, for the snail to open up the strong lid with which it is provided. In America, *Phenogodes* is known to feed upon myriopods, and *Pyractomena lucifera* lives in salt marsh meadows among snails. McDermott (1910), in speaking of the larva of *Photuris pennsylvanica*, says: "These larvæ appear to be semi-aquatic in habit; at this time of the year (early September), while walking along the edge of Rock Creek, in Rock Creek Park, Washington, D. C., numerous points of greenish light, which glow slowly and then die out slowly, to glow again in a moment or so, may be seen at the very edge of the water; on investigation these proved to be the larval forms of *Photuris* clinging to moist stones, weeds, etc., and presumably preying upon the smaller living things there." On the evening of September 8, 1913, I chanced upon three *Photuris* which were disposing of a large limp earthworm they had evidently overcome a few minutes before my arrival. This is the only occasion on which I saw *Photuris* larvæ feeding in the field. In the laboratory they readily devoured cut-up insects, which they left as mere shells. Certainly snails appear to be far too scarce in

this vicinity to furnish even a little of the food. The larvæ would not touch living slugs in the laboratory, but earthworms, particularly those which had been wounded, were often attacked and eaten. A good-sized earthworm was placed in a jar with several larvæ. In the bright electric light but one was bold enough to affix itself to the hinder part of the worm, with its prothorax bent down towards its prey. It allowed the worm to pull it about, and let drag its expanded prolegs, chewing steadily and relentlessly the while. Apparently the worm suffered partial paralysis in the attacked region since it retaliated but feebly, except at the first few tweaks. In the morning the worm was found dead, with several larvæ feeding upon it. One end was quite eaten away, and here and there along its remaining length was a number of lumps which were evidently the result of bites. Another worm in the same dish remained uninjured. A decidedly large and vigorous worm, about four inches in length, was left over night in a battery jar half filled with earth and containing about thirty large larvæ. One end of the creature had been previously injured but the animal was nevertheless quite active. At 10 P. M., upon examining the jar after it had been kept in darkness for some time, it was found that the worm had been attacked and was being devoured at three different points, including the wounded end. I counted fifteen larvæ engaged at this repast. The worm was still capable of slow movement, and, if squeezed with a pair of forceps, of considerable activity. The next morning revealed a number of much distended larvæ, feeding on the remnants of their prey—two pieces, one a mere stub, the other a somewhat flaccid piece an inch and a quarter in length. It is quite probable that while earthworms form a good proportion of the food of *Photuris*, it must feed upon a diversity of other forms. The mandibles seem to be blunter and much stouter than those of most lampyrid larvæ so that the creature may devour what it can overcome. Not being provided with salivary glands, it must, like many other carnivorous beetle larvæ (Carabidæ, Dystiscidæ, etc.), inject an alimentary poison, probably secreted by the midgut, into its prey.

Unlike the more slender *Photinus*, the *Photuris* larva is hardly subterranean in its nocturnal habits and is doubtless a more extensive traveller. By the end of October, I could find but few larvæ in the field. The ones confined indoors were for the most part resting

upon the floor or suspended from the roof of well-formed cells, under a thick strip of mossy soil, but owing to the indoor warmth, none of these larvæ was in a truly resting state. The abnormal laboratory conditions were probably responsible for the development of prothetely in two individuals (see *Psyche*, XXI, p. 126, 1914). Several pupated indoors, in February and March, but the majority transformed during May. Evidently the winter larval cells are not the pupal chambers, for these were largely deserted in the spring, when the insects took some food. On March 31, 1915, I found a few second-year *Photuris* larvæ hibernating under small stones, in earthen chambers. Situated as they are, from one to several inches below the surface of the ground, they successfully pass through the rigorous winters of New England.

A pupating larva rests quietly on its back, with the head quite extruded by the developing pupal head; the skin finally splits along the mid-dorsum and the pupa is disclosed. Pupating larvæ have a diffuse glow. But one pupa was found in the field, and the moist soil which I had slightly disturbed with my foot revealed this decidedly effulgent specimen. The pupa has an extended length of 11 mm. and an arcuate length of 9 mm. It is robust and somewhat less arcuate than *Photinus* pupæ, and has the hind legs free for a considerable distance. The head and appendages are translucent whitish, the abdomen is more opaque and with a slight creamy yellow tinge dorsally. This tinge extends up to and includes the metathorax, the yellow being divided by the line of the dorsal vessel. The insect is nowhere pinkish. The thin free edges of the first abdominal segments are somewhat drawn out laterally and dorsally and bear a loose tuft of brown hair; more such hair occurs at the end of the abdomen and especially along the edges of the prothorax and more sparsely along the posterior border of the abdominal segments. The pupa retains the two steady and strongly luminous points of the larvæ on the eighth abdominal segment, and, in addition, the head and the thorax are effulgent, so that it can be seen in the darkness for a distance of a dozen feet or more. At times the abdomen is faintly luminous, and when near emergence the adult light-organs also function. The pupal period is quite brief. The pupa is rather active, wriggling decidedly. The larval lights as well as the diffuse glow of the head and thorax disappear when the adult hatches, or shortly thereafter. I ob-

served an adult female bred in the laboratory, and probably a day old, which on being brought into darkness, was found to have the adult as well as the larval light-organs shining steadily, and in addition, the vertex and frons of the head (where the chitin was transparent) shone also. The dorsum of the thorax down to the abdomen, in the more transparent portions, had an unmistakable glow. Such conditions however were not found in the field, nor upon dissecting older specimens. It is evident that a considerable time must elapse after it has hatched from the pupa before the insect is really firm and mature, when the photogenic granules are seen to glow only in the luminous organs of the adult.

But little was done on the internal anatomy of this insect. The larval digestive and nervous systems are practically the same as in *Lampyris noctiluca*, as figured by Vogel (1915). If we compare the nervous system of the larva and adult *Photuris*, the following points will be noted: the larva has a total of thirteen distinct ganglia in the nervous system, the adult twelve; in the former the brain is in the cervical region, behind the head, and the last two abdominal ganglia, the seventh and eighth, the latter being compound, are separated by a distinct though comparatively short pair of connectives; in the adult the brain, of course, lies within the head and is more closely connected with the subesophageal ganglion, the first abdominal is very near to, though distinct from the third thoracic ganglion and the seventh and eighth are fused into one oblong ganglion with a median constriction. Thus it is seen that there is no considerable difference between these generalized systems in the larva and adult.

RESUMÉ.

1. Biological studies were made on six different species of fireflies in New England, viz., *Photinus consanguineus*, and *scintillans*, *Ellychnia corrusca*, *Lucidota atra*, *Pyratomena* sp. and *Photuris pennsylvanica*.

2. Of these, *Photuris pennsylvanica* is the most brilliant and *Ellychnia corrusca* the faintest in luminescence in the adult stage.

3. In the case of *Photuris* and *Photinus* at least, the larval light organ is different from that of the adult one which replaces it at maturity.

4. The light organ of the adult is probably used chiefly for the

bringing together of the male and female, is more brilliant in one than in the other sex and is readily controlled.

5. The adult female of *Photuris* is carnivorous and very voracious and even cannibalistic. The other genera seem to be herbivorous as adults.

6. Ova were obtained from all but *Pyractomcna*. They are sub-spherical and at first sticky and less than 1 mm. long. They are deposited a short distance in soil, moss, etc. That of *Photuris* has a yellowish tinge, the remaining five are dull whitish. All are for a time at least faintly luminous.

7. The larvæ of *Photinus*, *Ellychnia* and *Lucidota* are elongate and somewhat depressed and more or less pinkish ventrally—those of *Pyractomcna* and *Photuris* are wider, flattened fusiform, and the latter is nowhere pink. The larvæ of *Photinus* and *Lucidota* are very largely subterranean, but *Pyractomcna* is probably in part arboreal while the largely terrestrial *Photuris* frequently ascends weeds.

8. The larvæ are probably all carnivorous and *Photuris* devours earthworms with avidity.

9. The larvæ are all luminous—two points on the eighth abdominal sternite furnish the rather slowly controlled luminescence.

10. The larval life, perhaps with the exception of *Ellychnia corrusca*, extends in most cases over the greater part of two years.

11. *Ellychnia corrusca* hibernates as an adult beneath moss, logs, etc., the rest hibernate as larvæ.

12. The pupæ are luminous. The pupa of *Pyractomcna* is pigmented and suspended like that of a Coccinellid, the others are pallid and formed beneath the ground. This stage is brief.

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A NEW VARIETY OF SCAPHINOTUS.

BY CHARLES W. LENG,

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The specimens in our collections under the name *Scaphinotus* (or *Cychrus*) *ridingsii* Bland include two forms, as I was first informed by Mr. H. S. Barber, of the U. S. National Museum. One form inhabits the region drained by the Potomac River and is the form first described by Bland, his type locality being "Hampshire Co., Virginia,"¹ which since the separation of West Virginia, has become part of the latter state and is near the source of the Potomac. Other specimens of this typical form were collected by myself near Warm Springs, Bath Co., Virginia, in October, 1899, by sifting deep accumulations of leaves in the woods or by seeing them cross the path at dusk. In recent years, nine specimens of the typical form have been found near Washington, D. C., on the Virginia shore of the Potomac, opposite Plummer's Island. Two of these were found at night by Mr. Barber while hunting food for his Lampyride larvæ. All these typical *ridingsii* have thus been found near the Potomac River or its tributaries.

A different form, distinguishable by its broader shape, shorter and more coarsely punctate elytra, inhabits that part of Pennsylvania drained by the Monongahela River and its tributaries and is apparently more common in collections than the typical form, with which it has been confused. It is first referred to by Bland a year after his original description in his statement that Mr. H. Ulke "captured several specimens in the neighborhood of Altoona, Pa."² It was the form before Dr. Geo. H. Horn when he wrote "the specimens I have seen were all collected by Mr. Ulke, near Cresson Springs, Pa."³ and the basis of his comparison of *ridingsii* with "a diminutive *andrewsii*"; and has perhaps become for many collectors the sole representative of Bland's species. However the difference has not remained unnoticed for Mr. Chas. Liebeck gave in *Entomological News*⁴

¹ Proc. Ent. Soc. Phil., I, 1863, p. 353.

² Proc. Ent. Soc. Phil., II, 1864, p. 323.

³ Trans. Am. Ent. Soc., VII, 1878, p. 174.

⁴ Ent. News, X, p. 193; pl. VI, figs. 10-12.

in 1899 figures of three forms of *ridingsii* from Virginia, Pennsylvania and Tennessee, and called attention to the narrower form and finer punctuation of the typical form. Dr. Hans Roeschke in his Monograph of the tribe Cychrini⁵ cites Liebeck's article but includes without discrimination the localities Pa., Va., W. Va., Tenn., contenting himself with the remark that the Tennessee form "seems from the figure to be unusually large, broad and compact."⁶

Recently Mr. W. S. Fisher of the U. S. National Museum, has sent me four specimens of the Pennsylvania form; there is another in the collection of the American Museum, and about forty in the collection of Mr. G. W. J. Angell of New York, all, I believe collected by Mr. T. N. Brown, of Uniontown, Fayette Co., Pa. From correspondence with Mr. Brown I learn that they have been taken in the deep gorges running back into Chestnut Ridge, the most western ridge of the Allegheny mountains and especially in one restricted locality in a deep, heavily timbered valley, where several species of snails are plentiful. Six were found under one small stone engaged in feeding on small snails and frequently the beetles clung to their food until transferred to the killing bottle. Other localities from which specimens of this form have been seen are Charleroi, Washington Co., Pa., and Wall, Allegheny Co., Pa.; all these localities are in a region west of the mountain divide and drained by the Monongahela River, the waters of which reach the Gulf of Mexico, through the Ohio and Mississippi, while the waters of the Potomac reach the Atlantic Ocean. The divergence in the Cychrini caused by the faunal boundary of the Allegheny Mts., which has already⁷ been pointed out in the variations of several other species is therefore again illustrated by these two forms of *ridingsii*, the typical form occurring in the Potomac valleys and the other form, which I propose to call variety

⁵ Ann. Mus. Hung., 1907, p. 150.

⁶ It may be noted that Dr. Roeschke does not include Bland's 1864 reference in his bibliography and quotes the length 12.5 mm., given by Horn without investigation. Dr. Henry Skinner has kindly remeasured the specimens in the collection of the Amer. Ent. Soc. which include Bland's type and Horn's specimens, and writes me "the type from Virginia measures 15 mm. . . . the other four measure 17, 17, 18, and 18.5 respectively." As Horn's measurement was made from the latter, it may be stated with certainty that his "12.5 mm." is simply a typographic error for 17.5 mm.

⁷ JOURN. N. Y. ENT. SOC., XXII, 1914, p. 139.

monongahelæ occurring in the Monongahela valleys west of the mountains.

***Scaphinotus ridingsii monongahelæ* n. var.**

Similar to *S. ridingsii* in the fine complete striation and in the tarsal characters of the male and varying similarly in color, but differing in the form of the thorax, which is broader in front of the middle but equally narrow at base, allowing the flanks to be partially seen from above; and differing especially in the form of the elytra, which are shorter, broader, more regularly and evenly arcuate at the sides, broadest at middle, and in the punctures of the elytral striæ, which are coarser. Length, 17-18 mm.; width, 7-8 mm., the ♀ slightly broader than the ♂.

Type, ♂, in my collection, from Uniontown, Pa. Other specimens from the same locality are in the collections of W. S. Fisher, U. S. Nat. Mus., G. W. J. Angell, and Am. Mus. Nat. Hist. The width of typical *ridingsii* is 6-7 mm., and the broadest ♀ I have seen is no wider than the ♂ of *monongahelæ*.

Since this article was written, Mr. Liebeck has kindly allowed me to examine his Tennessee specimen, which was found by a conchologist while hunting snails. It also belongs with var. *monongahelæ*.

A NEW SPECIES OF THE GENUS ANTHOPHILAX LEC. (COL.).

BY EDWIN C. VAN DYKE,
BERKELEY, CAL.

The species which I am describing has been represented for some time in my collection, and though a unique, is sufficiently distinct to warrant me in naming it and I do that now in order that Mr. Alan Nicolay, who is reviewing the genus may have all of the species to pass upon.

***Anthophilax nigrolineatus* new species.**

Quite robust, somewhat convex; piceous black except elytra which are yellow with basilar margin, a moderately broad common sutural stripe, another but narrower stripe extending from humeri to apex and joining with the sutural, a narrow marginal bead of a deep black, abdominal segments which have a reddish cast; head and pronotum covered with a very fine, sparse, and yet distinct, yellowish pubescence, apices of the elytra also slightly pubescent and the under surface clothed with a longer and denser pubescence of the

same color. Head rather finely densely punctate in front and much more coarsely so between eyes and on occiput, canaliculate between the antennæ; the antennæ five sevenths as long as the body, with the first joint large and longer than the second and third together, the second small and transverse, the third about three times the length of the second, two thirds the length of the first, slightly longer than the fourth and broader than either second or fourth, the fourth a little bit longer than one half the fifth. Prothorax two fifths wider than head and wider than long, base slightly wider than apex and about as wide as head, apex feebly arcuate, base slightly lobed at middle, sides strongly, obtusely tuberculate at the middle; disc rather coarsely and confluent punctured, the sides more finely so, the entire surface like the head having a granulose and opaque appearance and with a shallow fovea at middle. Elytra at base slightly less than one third wider than the thorax and not quite twice as long as wide, the humeri prominent, the sides almost straight and very convergent to posterior third where they gradually round to near apex which is subtruncate; disc very coarsely but not closely punctured from base to middle, thence rapidly more finely punctured to apex. Length 14 mm., width 5 mm.

The type, a unique male, was collected in the subalpine region of Mt. Jefferson, Oregon, July 20, 1907, by Mr. J. C. Bridwell, and deposited with me by Professor H. F. Wilson.

This species has in common with the other western species, the same general type of antennal structure, but otherwise seems to stand apart. It in many ways suggests *A. subvittata* Casey and most likely is more closely related to that than to any other, but it differs from that not only by being larger and more robust, but by having differently colored antennæ and legs, a different type of punctuation on pronotum, a proportionally much shorter elytra and with a more definite color pattern. From *A. tenebrosus* Lec. it differs markedly, not only as regards color but by being more grossly punctured and by having proportionally broader and more cuneate elytra; from *A. mirificus* Bland it differs even more. The range of this conspicuous species is probably throughout the true fir forest belt of the southern Cascades.

SYNOPSIS OF THE ANTHOPHILAX OF NORTH AMERICA (COL.).

BY ALAN S. NICOLAY,

BROOKLYN, N. Y.

After taking several beautiful green specimens of this genus while collecting in Maine during the month of May, 1916, I became greatly interested in the species of this group. While comparing specimens with descriptions and all available material, I found the greatest confusion existed in separating our forms. So at the suggestion of Mr. Charles W. Leng, who has ever been ready with advice and kind offers of assistance, I decided to revise the group including all the new forms.

Without the help and complete records of Dr. Edwin C. Van Dyke, I am afraid our western species would still be in considerable confusion, but he very kindly came to the rescue, not only revising my key but also adding a new species, our eighth, to the genus.

Through the kindness of Mr. Andrew J. Mutchler by permission of Dr. Frank E. Lutz I have been able to examine the material in the American Museum of Natural History. Mr. Charles Schaeffer allowed me to inspect specimens in the collection of the Brooklyn Museum. I also have to thank Messrs. William T. Davis, W. S. Fisher and Ernest Shoemaker for records and loan of material.

All the species inhabit mountainous districts preferably the higher altitudes and are quite rare in collections.

The genus *Anthophilax* was erected in 1850 by Le Conte¹ to separate those forms having dilated labial palpi, head constricted behind eyes, eleven jointed antennæ inserted between the eyes, which are emarginate; thorax with rectangular hind angles moderately constricted on each side and acutely tuberculate at sides.

TABLE OF THE SPECIES OF ANTHOPHILAX LEC.

- | | |
|--|---|
| 1. Third joint of antennæ long, as long or longer than the first and distinctly longer than fourth | 2 |
| Third joint of antennæ relatively short, shorter than the first and equal to or but slightly longer than the fourth..... | 5 |

¹ Agassiz and Cabot, "Lake Superior," 1850, p. 236.

it occurs, most specimens were taken flying. I beat one female from the half dead pine needles where I took *malachiticus*.

A. malachiticus (Haldeman).

Stenura malachitica Hald., Trans. Am. Phil. Soc., New series, 1845, p. 64.

Stenura cyanea Hald., Proc. Acad. Nat. Sci. Philad., 1847, Vol. III, p. 151.

Pachyta leonardi Harris Mss.

Head and thorax green or bronzed, punctures coarser than in *viridis*, but not so much so as in *hoffmanii*, apex of antennæ reddish, elytra splendid green, sometimes bronzed, scabrous, with dilated, impressed punctures, scutellum black, trophi and feet testaceous, tarsi and outer half of tibiæ brown, prothorax with a lateral tubercle. Male body decidedly wedge shaped, antennæ black except with touch of red at basal joints, female body more oblong, antennæ annulate. Length 12-16 mm.

Jackson, N. H., June 5 (E. D. Harris), Hampton, N. H., June 13 (Shaw), Marquette, Mich., June 28, in wash up (Sherman) Cumberland Co., Maine (near Douglas Hill), May 18-June 14 (Nicolay), Rock City, Cattaraugus Co., N. Y., June 7 (W. T. Davis), Fort Montgomery, June 14, beating blossoms (Schott), June 30 (H. G. Barber), Somerset County, Pa.

Although rare this is the green species most generally taken. My specimens were beaten from half dead pine needles, from off the tops of trees felled the previous winter. I never took a specimen from a completely dead or dried up cluster of needles, nor from a live and healthy tree. By beating branches all morning I would be lucky in securing one specimen. Besides differing from *viridis* in color of the legs, the very great contrast both in color and punctuation of thorax ought to dispense for all time with the thought that they are the same species.

A. viridis Leconte.

A. viridis Lec., Agass. L. Sup., 1850, p. 236.

Black, head and thorax brassy, discretely and not deeply punctured, gray-pubescent, the latter narrowed in front, constricted on each side, with a shallow channel, spined (not very acutely) at the sides, elytra with large confluent punctures, substriate, splendid green-bronzed, rounded at apex, apex of antennæ and base of tibiæ reddish. Male body decidedly wedge-shaped, antennæ black, except with slight touch of red at basal joints, female body more oblong, antennæ distinctly annulate. Length 13-16 mm.

The description is copied from Le Conte's with a few changes. The specimens I have seen have the head and thorax black and slightly brassy, not virescent as Le Conte said. The species also pos-

sesses striking sexual characteristics, the female being readily told from male by annulate antennæ, and less wedge shaped body.

This longicorn is extremely rare and very local, evidently preferring the highest peaks of mountain ranges. Mr. Ernest Shoemaker is the only local collector fortunate enough to take the species, capturing one male on top of Whiteface Mt., Adirondack Range, N. Y., July 13, and one beautiful green female taken on blackberry blossoms at Slide Mt., Catskill Range, N. Y., July 4. Other records are Marquette, Mich., June 28, in wash up on shore of L. Superior (Sherman), Eagle Harbor, Mich. (Le Conte), Mt. Graybeard, N. C., July, on rhododendron flowers (Van Dyke).

A. hoffmani Beutenmuller.

A. hoffmani Beut., Bull. Am. Museum, Vol. XIX, pp. 518-519, 1903.

Head and thorax bronzed black, deeply and confluent punctured. Head with a median sulcus in front, carinate on each side from below the antennæ to mandibles. Thorax scabrous, with antebasal transverse ridge, narrower in front than behind, a median depression on the anterior half, anterior portion somewhat constricted, hind angles rather prominent, produced by the lateral depression, on each side at the middle is a prominent spine-like protuberance. Antennæ black, elytra bright shining green, red laterally, rugosely reticulated; humeri prominent; scutellum black. Underside black or brassy black with very short whitish hairs, finely rugose. Legs brassy black, pubescent; tibiæ somewhat rufous basally. Male antennæ as long as body; female antennæ reach to one third from tip of elytra, hind angles of thorax more produced, the lateral protuberances longer and more pointed and body more robust than in the male. Length ♂, 13-15 mm., ♀, 18-20 mm.

Summits of the Black Mts., western North Carolina, June 26-July 11.

Ten specimens of this most beautiful *Anthophilax* were taken by Mr. Beutenmüller and Dr. Van Dyke on the balsam fir (*Abies frazeri*), one female being found ovipositing in same.

I have had the privilege of examining types in the American Museum and am fully convinced it is distinct. The characteristics given in the key make its separation easy. Also, as Dr. Van Dyke points out, it can not be regarded as a geographical variety of *viridis*, the species it most nearly approaches and of which a specimen was taken in the same locality only three miles away.

A. tenebrosus Leconte.

A. tenebrosus Lec., S. M. C., No. 264, 1873, p. 208.

Black, head and thorax closely, but feebly punctate, thorax moderately constricted in front and behind, with a short obtuse lateral tubercle. Elytra

moderately densely punctured, grossly toward base and finer toward apex, more shining at base than at apex. Third antennal joint longer than fourth. Eyes subtriangular, strongly and broadly emarginate at the antero-interior side. Length 12 mm.

Lake Tahoe Region, June 22–July 15, Yosemite Region, Tuolumne Meadows, August 2, Southern Sierras, Monarch Lake, Tulare Co., July 10, Cal. (Van Dyke), S. E. Cal. (Horn).

Dr. Van Dyke says "this is a high altitude species, generally found from 7,000 to 11,000 feet and usually about fir in which it probably breeds. I think that it ranges throughout the High Sierras and perhaps also in Oregon, though I have not seen any specimens from the Cascades." Dr. Van Dyke has taken somewhat over eight specimens, the males and females occurring in about equal numbers. From comparison made between one of these and *mirificus*, *tenebrosus* appears to be a narrower insect.

A. *mirificus* Bland.

A. mirificus Bland, Proc. Ent. Soc. Phil., 1865, p. 382.

A. venustus Bland, Proc. Ent. Soc. Phil., 1865, p. 383 (female).

Male.—Head and thorax black, coarsely punctured; head deeply impressed between the antennæ, surface of the thorax uneven, a deep dilated central line and deep transverse lines near the anterior and basal margins, lateral margins nearly straight, with a strong obtuse tubercle. Elytra dull velvety red with scutellar area and subapical spot black, basal half deeply but sparsely punctured, becoming less distinct on apical half. Beneath minutely punctured, segments rufous. Antennæ nearly length of body, third and fourth joints equal, basal joints shining. Palpi rufous, mandibles rufous, at middle. Scutellum triangular, closely punctured. Legs black. Length 14 mm.

Female.—Entirely black, clothed with short, erect, brownish hairs. Head grossly punctured, somewhat shining, central line deeply impressed between the antennæ, becoming obsolete near the base, a broad transverse depression back of the eyes. Antennæ about one half the length of the body, third and fourth joints equal, fifth as long as the third and fourth combined. Palpi piceous, mouth furnished with dark brown hairs. Thorax uneven, grossly punctured, opaque, a deep transverse line near the anterior and posterior margins, central longitudinal line dilated; a strong, obtuse, polished tubercle on the side. Scutellum triangular, closely punctured; humeri prominent, lateral margins parallel to the rounding of the tip, posterior half opaque, minutely rugose, dorsal surface flattened, sides gradually depressed. Beneath black, shining, closely and neatly punctured. Length 19 mm.

Kamas, Utah, June 5–21; Buford, Colorado, July 27; Columbia Falls, Montana, June 7; Haines, Oregon, August 3; Centerville, Idaho,

June; Yreka, California (Forest Insect Coll. in U. S. National Museum), Boise, Idaho, June 30 (Nicolay collection).

Because of the striking difference in appearance of the sexes, the female was described by Bland in the same paper with *mirificus* under the name *venustus*. Also because of the great scarcity of material considerable confusion existed in separating not only the female from specimens of *tenebrosus*, but even as regarded certain characteristics attributed to the male. In every male specimen examined the basal half of the elytra is deeply but sparsely punctured, becoming less distinct on the apical half. I can not quite understand what Horn had in mind when he wrote "impunctate" in his table, unless in comparing it with the females he noted that the basal half was not scabrous, as in the female. This is also the only species having the third and fourth antennal joints equal in length. It is through the kindness of Mr. W. S. Fisher, who made several visits to the National Museum, that I am able to clear up the doubtful points about this species.

A. subvittatus Casey.

A. subvittata Casey, Ann. N. Y. Acad., 1891, Vol. VI, p. 37.

Piceous black, moderately robust, rather convex. Elytra pale luteo-testaceous, with a broad common sutural and narrow submarginal vitta of piceous-black, the vittæ generally feebly marked, sometimes evanescent. Legs and antennæ piceo-testaceous. Head finely, densely punctate, finely canaliculate between the antennæ, the latter three fourths as long as body, third joint distinctly longer than fourth, but much shorter than fifth. Prothorax slightly wider than head, a little wider than long, apex slightly narrower than base, both feebly arcuate, sides strongly, obtusely tuberculate at middle, disk finely, densely punctate. Elytral pubescence extremely short and sparse, consisting of very minute erect setæ borne from punctures; base not more than one third wider than prothorax, about two and one third times longer than wide, sides distinctly convergent from base to apex; disk very coarsely and sparsely punctate toward base, becoming finer toward apex and along suture. Length 9.3-11.0 mm.

Colorado (?)

The five specimens in Casey's collection and one in the Leng collection are without definite locality. However as the material in the Casey collection is from the Levette cabinet, he believes in all probabilities the specimens were taken in or near above region. The beetles seem to be all males. This species resembles *A. nigrolineatus* Van Dyke more closely than any others, but may be readily sep-

arated by being smaller, less robust, having different colored antennæ and legs, a proportionally much longer elytra with a less definite color pattern, and also several other minor differences.

A. nigrolineatus Van Dyke.

A. nigrolineatus Van Dyke, Jour. N. Y. Ent. Soc., 1917, Vol. XXV, p. 36.

Quite robust, somewhat convex, piceous black except elytra which are yellow with basilar margin, a moderately broad common sutural stripe, another, narrower, stripe extending from humeri to apex and joining with the sutural, and a narrow marginal bead of deep black, and the abdominal segments which have a reddish cast. Head and pronotum covered with a fine, sparse, and yet distinct, yellowish pubescence. Apices of elytra slightly pubescent, under surface clothed with a longer and denser pubescence. Head rather finely densely punctate in front, more coarsely so between eyes and on occiput, canaliculate between antennæ. Antennæ five-sevenths as long as body, first joint large, longer than second and third together, third slightly longer than fourth. Prothorax two fifths wider than head, wider than long, base slightly wider than apex, about as wide as head, apex feebly arcuate, base slightly lobed at middle, sides strongly, obtusely tuberculate at middle, disc coarsely and confluent punctured, sides more finely so. Entire surface with a granulate and opaque appearance, with a shallow fovea at middle. Elytral disc very coarsely, but not closely, punctured from base to middle, thence more finely punctured to apex. Length 14 mm.

Mt. Jefferson, Oregon, July 20 (J. C. Bridwell).

The type, a unique male, is in the collection of Dr. Van Dyke. It was collected in the subalpine region of Mt. Jefferson and probably ranges throughout the true fir forest belt of the Southern Cascades.

THE GENERA OF HYDRIOMENINÆ OF THE UNITED STATES (LEP.).

WM. T. M. FORBES,
WORCESTER, MASS.

Our knowledge of the Geometridæ has been much increased since Hulst's paper in the Trans. Am. Ent. Soc., and general ideas of the relative values of the characters he uses are somewhat changed. The following paper is an attempt at a somewhat improved alinement, as well as at a more workable key to the genera, which should avoid the errors which more recent workers have discovered in his tables.

As the primary purpose is if possible to furnish an aid to the identification of North American material, I have based my primary tabulation on the male sex; in Hulst both sexes are necessary for identification. For the same reason I have avoided as far as possible names whose application is, or has lately been in dispute, believing that even a fair proportion of names that would prove synonyms would cause less confusion than a very few, even, which have now or lately been applied to more than one genus. Thus I have dropped a couple of Cramer's and Hübner's names, misidentified by Hulst, and have referred to the species under dispute by names which may prove synonyms on further study, but which I believe at least unambiguous.

The arrangement of the Hydriomeninæ has been made fairly complete for both sexes, as a large proportion of the genera can be defined on other than secondary sexual characters. I have followed the general European usage and treated as a single genus the central mass of species, which show no clean-cut structural characters. An analysis of such characters as I have been able to appreciate, has been added in a note. Some time this genus (*Hydriomena*) will be divided, but not along any lines yet proposed. Hampson's character of the course of the middle discocellular of the hind wing is the most nearly natural of any yet proposed and, in our fauna at least, is correlated with the presence or absence of coremata in the male, but it fails in the cæsiata group. *Silaccata* also belongs by habitus to the group which it least resembles structurally; as the coremata are weak in it it may be a true intermediate. It belongs to a considerable Oriental group, whose genitalia have not been examined.

Hulst's discussion of the characters used in classification leaves comparatively little to be said. I have found the hind tibial pencil less useful than he did, largely because it is often evanescent (as noted by Pearsall in the genus *Epimccis*). Like most secondary sexual characters, if not used cautiously it will separate closely related species. The tuft of the thorax in the *Hydriomena* group is probably a natural character of a certain importance. Practically it is useless, as a very large proportion of available material is rubbed; in fact a large proportion at least of Hulst's *Canocalpes* possess the tuft. At this point I have fallen back on a very unsatisfactory character, the wing-pattern, to separate *Stamnodes*, and have let the more typical *Canocalpes* (which in fact have the thoracic tuft) fall back into *Hydriomena*.

The determination of the sexes is in general easy in the Geometridæ. Aside from the fact that the claspers of the male, and ovipositor of the female can usually be seen, the multiple frenulum of the female (which in the Geometridæ is a bundle of bristles of unequal strength) is characteristic, except in *Operophtera*, where it is multiple in the male and the female is wingless. *Operophtera* has heavily fasciculate antennæ unlike any female known to me. The simple frenulum always marks the male in this family. In the Geometrinæ and Palyadinæ it will be necessary to combine the sexes in a single table.

The Dyspteridinae have been combined with the Hydriomeninae, for reasons already given by Pearsall; the Monotaxiinae are based on a single sexual character which occurs in several otherwise unrelated genera, and so the group has been dropped. Hulst's Monocteniinae are entirely recast, as indicated by Prout in the Genera Insectorum. Of his genera *Mcclanomma* is a Noctuid, and the other three are Sterrhids of three different tribes.

Notes have been added to the key giving changes in generic content and placing the more important exotic genera. I had hoped to review the South American genera with some care, but Warren's descriptions are so brief that I could make nothing of them, except where I had a chance to see specimens in the U. S. National Museum. Several of his names will have to be used in our fauna, especially in the Boarmid series, and for sections of Hydriomena. Meyrick does not give the condition of the middle discocellular in the hind wing in his papers, so that I was unable to place the genera not represented in the American Museum of Natural History, but I have indicated one or two places where I think his name may have to be used. A surprisingly large proportion of the North American genera are represented in Australasia, in fact the family is more nearly cosmopolitan than any other group I know.

KEY TO SUBFAMILIES OF GEOMETRIDÆ:

1. Wingless (females)2
1. Wings from about 1/16 inch long to pupal size (females).....3
1. Wings slightly reduced or normal.....5
2. Hind tibia longer than tarsus, with well developed spurs; moth brown, smoothly scaled.....*Rachela* in **Hydriomeninae**.

2. Hind tibia shorter, or with rudimentary spurs; or vestiture overlaid with loose hair, or black and white.....**Ænochrominæ** and **Ennominæ** (2).
3. Abdomen spined dorsally.....*Phigalia* in **Ennominæ**.
3. Abdomen not spined dorsally.....4
4. Front smooth, palpi short.....*Paraptera* in **Hydriomeninæ**.
4. Frontal tuft and palpi projecting beaklike...*Diastichtis* in **Ennominæ** (1).
5. M_2 (vein 5) of hind wings well developed, tubular.....6
5. M_2 of hind wing rudimentary or absent.....11
6. M_2 from decidedly above middle of cell in both wings; our species with enlarged humeral angle, reduced or wanting frenulum; almost always green and always simply marked.....**Geometrinæ**.
6. M_2 at least two thirds as far from top as from bottom of cell in at least one, and usually both wings.....7
7. Sc and R of hind wing fused near base for less than a quarter length of cell, or in contact and immediately and abruptly diverging.....8
7. Sc and A fusing for more than a quarter length of cell, or shortly near end of cell9
7. Sc and R entirely separate, connected by a distinct cross-vein, more than a third way out on cell.....a few **Hydriomeninæ**.
7. Sc and R separate but closely approximate for second fourth of cell, at least, the cross-vein if present obscure and located where Sc and R first approach10
8. Frenulum absent, antennæ clubbed.....**Coronidiinæ** (3).
8. Frenulum and antennæ normal.....**Sterrhinæ** (4).
9. Tongue well developed, one or two well marked accessory cells.
Hydriomeninæ.
9. Tongue rudimentary; radial branches crowded toward origin, not enclosing a distinct accessory cell.....*Alsophila* in **Ænochrominæ** (5).
10. R_4 of fore wing running to costa about 1/16 inch before apex, no accessory cell; eyes and mouth-parts very small; very hairy; eyes oval..**Brephinæ**.
10. R_4 running to apex; or with normal accessory cell, vestiture, eyes, or palpi and tongue, eyes round.....**Ænochrominæ** and **Ennominæ**.
11. Two large accessory cells in fore wing not connected to Sc.
Grossbeckia in **Hydriomeninæ**.
11. With one or no accessory cells, or with them rhomboidal and the first connected to Sc.....most **Ennominæ**.

NORTH AMERICAN GENERA OF BREPHINÆ.

- M_3 and Cu_1 stalked, at least in hind wing; hind wing white..**Leucobrephos**.
 M_3 and Cu_1 not stalked in hind wing; hind wing orange.....**Brephos**.

NORTH AMERICAN GENERA OF HYDRIOMENINÆ:

MALES:

1. Sc and R connected by a crossvein, Cu_2 extremely reduced in hind wing..2
1. Sc and R fused, at least toward end of cell.....4

2. Hind wings extremely reduced, with rudimentary cell; green. **Dyspteris** (6).
2. Not green3
3. A defined lobe at base of inner margin of hind wing, Sc and R closely parallel **Trichopteryx** (7).
3. Hind wing crumpled on inner margin, Sc and R well separated.
Heterophleps (8).
4. Fore tibia with terminal claw5
4. Fore tibia unarmed6
5. Hind wing without anal vein, with specialized pocket opening upward, at base of inner margin **Eucestia** (9).
5. Hind wing normal **Marmopteryx** (10).
6. Fore wing with a folded translucent portion toward, but not including, inner margin7
6. Fore wing evenly scaled, rarely folded in repose, M_2 of hind wing developed8
7. M_2 of hind wing absent, translucent portion of fore wing about a third width of wing..... **Grossbeckia** (11).
7. M_2 present, translucent fold much narrower..... **Catoclothis**.
8. Hind wing with a membranous lobe at base of inner margin, supported by the rudimentary anals..... **Lobophora** (12).
8. Hind wing with a small specialized pocket at base of inner margin, preceded by a translucent area; Sc and R shortly fused toward end of cell, anals rudimentary **Carsia** (13).
8. Hind wing with one anal at least fully developed, the inner margin less modified; Sc and R fused on second quarter of cell.....9
9. Fore wing with middle discocellular long and bent, causing M_2 to appear to belong to the cubital system in both wings, frenulum rudimentary, multiple **Operophtera** (14).
9. Fore wing with mdev. less than twice as long as ldev.; straight except in a few *Hydriomenæ*, frenulum developed.....10
10. R_5 and M_1 stalked together in fore wing, separate from the single small accessory cell **Zenophleps** (15).
10. M_1 free or arising from the accessory cell (usually stalked in hind wing) . .11
11. Fore wing with R_2 and R_5 arising practically opposite each other at tip of accessory cell, wings with sparse hair-scaling, especially on under side.
Eudule (16).
11. Wings normally scaled or nearly so; when thinnest with R_2 arising far beyond R_5 12
12. Head and under side of thorax with rough hairy vestiture, especially on palpi; eyes about half as wide as front.....13 (17).
12. Head smoother, the palpi with largely scaly vestiture, eyes more than two thirds as wide as front.....14
13. Antennæ bipectinate **Psychophora** (18).
13. Antennæ simple **Trichochlamys**.
14. Hind tibiae with end-spurs only.....15

14. Hind tibiæ with both pairs of spurs.....16
15. With a single small accessory cell on anterior side of discal cell distinctly before its end; hind wing with Sc and R only shortly fused, but cell closed by a nearly transverse mdev.....**Synomila** (19).
15. Accessory cell reaching end of discal cell, often with M_1 arising from it; fusion of Sc and R in hind wing long.....**Gymnoscelis** (20).
16. Front rounded out half the width of the eyes or more (usually obliquely), close-scaled; small species with single acc. cell, and slight dorsal abdominal tufts like *Eupithecia*.....**Nasusina** (21).
16. Front less strongly rounded out, when most prominent (*Venusia*, etc.) moths of entirely different appearance.....17
17. R_1 running directly across from acc. cell, to Sc, like a cross-vein, the tip occasionally free**Chloroclystis** (22).
17. R_1 free after leaving acc. cell (as a rare aberration very shortly fused with Sc)18
18. A tuft near inner margin of hind wing, opposite end of abdomen.....19
18. No such tuft, the hind wing in our species not sexually modified.....20
19. Tuft black and very conspicuous, covering a hyaline patch; wings less deeply scalloped, male claspers normal.....**Calocalpe** (23).
19. Tuft fuscous and less specialized; end of abdomen broad with large claspers and specialized tufting; the wings more deeply scalloped.
Coryphista (24).
20. Fore wing with a hair-pencil on under side near base.....21
20. No hair-pencil on fore wing.....22
21. Mdev. of hind wing in our species short and straight, wings bluntly rounded.
Polythrena (23).
21. Mdev. long and bent; wings acute at apex.....**Lygris** (26).
22. Hind wings deeply scalloped, the tooth of M_2 about as strong as any.
Triphosa (27).
22. Hind wings with at most a somewhat wavy margin.....23
23. Middle discocellular of hind wing long and bent.....24
23. Mdev. no longer than lower, and straight.....28
24. Antennæ unipectinate**Monotaxis** (28).
24. Antennæ bipectinate, serrate or simple.....25
25. Front rounded and quite smoothly scaled, usually full as wide as eyes, curving in below to clypeus, the palpi hardly exceeding it.....26
25. Front at least rough scaled below, generally, and always when wider than eyes with a distinct conical tuft.....**Hydriomena** (series I) (37).
26. Two accessory cells, antennæ laminate, wings bluntly rounded, black and red**Ænotrus** (29).
26. Two accessory cells, wings more pointed, with simple markings above (the ground color most often yellow) and complexer below; practically all with laminate antennæ**Stamnodes** (30).
26. Antennæ various, accessory cell sometimes single, markings complex on a gray or white ground above, simpler below.....27

27. Branches of radius normally symmetrical on the stalk of R_{3+4} as an axis; two large accessory cells **Epirrita** (31).
27. R_2 arising far beyond R_6 , 1st acc. cell minute or absent..... **Venusia** (32).
28. Front rounded out, curving in to the small clypeus below, and quite smoothly scaled, the palpi hardly exceeding it, our species with one accessory cell **Euchæca** (33).
28. Front rough-scaled or with a conical tuft, or strongly projecting below, with the palpi projecting well beyond it.....29
29. Front fully as wide as eyes, the palpi very rough..... **Loxofidonia** (34).
29. Front narrower than eyes30
30. Hind wing with a distinct though slight angulation at M_3 and notched above, with wavy margin; the antennæ deeply laminate. .
- **Percnoptilota** (35).
30. Hind wing evenly wavy or rounded31
31. Abdomen with small, usually black dorsal tufts on several segments, fore and hind wings similarly marked with fine wave-lines; front and clypeus often extended to a point below, forming a beak with the palpi.
- **Eupithecia**, **Eucymatoge** and **Orthonama** (36).
31. Abdomen neither tufted nor black spotted *in the middorsal line*, clypeus never triangular, fore and hind wings only exceptionally similarly marked with fine wave-lines **Hydriomena** (series II) (37).

FEMALES :

1. Wingless or with rudimentary wings..... **Operophtera** (14).
1. Winged2
2. No frenulum, green with two white lines..... **Dyspteris** (6).
2. Frenulum present, not green and simply marked.....3
3. Fore tibia with claw4
3. Fore tibia unarmed5
4. Palpi beaklike **Eucestia** (9).
4. Palpi short, front smooth **Marmopteryx** (10).
5. R_5 and M_1 stalked together from cell in fore wing..... **Zenophleps** (15).
5. R_5 and usually M_1 from accessory cell.....6
6. Hind tibiæ with end-spurs only.....7
6. Hind tibiæ with all spurs9
7. Abdomen with small dorsal tufts (easily lost), hind wing longer to apex than to anal angle **Gymnoscelis** (20).
7. Abdomen smoothly scaled, hind wing full as long to anal angle as to apex..8
8. Fore wing with a single small accessory cell well before end of discal cell, with long oblique udcv..... **Synomila** (19).
8. Fore wing with large or double accessory cell, reaching end of discal cell; udcv obsolete **Trichopteryx** (7) and **Lobophora** (12).
9. R_1 apparently a crossvein, extending from acc. cell to Sc.
- **Chloroclystis** (22).
9. R_1 free from Sc (or as an aberration very shortly fused with it).....10

10. A translucent band on posterior half of fore wing, folded in repose....11
 10. No translucent area on fore wing.....12
 11. The band covering most of lower half of wing.....*Grossbeckia* (11).
 11. A narrow band in submedian space.....*Catoclothis*.
 12. Sc and R of hind wing separate, connected by a crossvein (R_1).

Heterophleps (8).

12. Sc and R fused shortly, near end of cell.....*Carsia* (13).
 12. Sc and R fused on second fourth of cell at least.....13
 13. Front strongly projecting (half the width of the eyes or more), smooth scaled*Nasusina* (21).
 13. Front less prominent, or triangularly extended at clypeus only, often with a conical tuft of hair.....14
 14. Wings translucent, the scales narrow, hairlike, R_2 and R_3 arising nearly opposite each other from the single acc. cell.....*Eudule* (16).
 14. Wings more normally scaled, R_2 arising far beyond R_315
 15. Eyes half as wide as front, vestiture very hairy.

Psychophora and *Trichochlamys* (17, 18).

15. Eyes wider, vestiture usually mostly of scales.....16
 16. Mdcv. of hind wing long and sharply bent, the lower half sometimes nearly longitudinal17
 16. Mdcv. short and straight, the lower often oblique.....23
 17. Outer margin of hind wing deeply scalloped, of fore wing wavy.....18
 17. Outer margin of hind wing at most a little wavy.....19
 18. Tooth at tip of M_2 hardly half as large as the others.....*Coryphista* (24).
 18. Teeth of hind wing practically equal.....*Triphosa* (27).
 19. Front rounded out, smoothly scaled, the palpi hardly exceeding it.....20
 19. Front rough-scaled and projecting below, much exceeded by the palpi as a rule22
 20. Black and red, simply marked.....*Enotrus* (29).
 20. Marks simple above, often with a yellow ground color, below more complex.

Stamnodes (30).

20. Marks complex above on a gray or white ground, simpler below.....21
 21. Two accessory cells*Epirrita* (31).
 21. First acc. cell rudimentary or absent.....*Venusia* (32).
 22. Both wings similarly marked with numerous brown and clay-colored wavy lines*Calocalpe* (23).
 22. Markings of other types, usually simpler on hind wings.

Lygris (26), *Monotaxis* (28) and *Hydriomena* (series I) (37).

23. Front rounded out, smoothly scaled (often contrastingly dark), the palpi hardly if at all exceeding it, the clypeus small.....24
 23. Front obliquely extended or rough-scaled below, the palpi usually extending well beyond it.....25
 24. Black, fore wing bluntly rounded, humeral cell of fore wing in our species a fourth as long as discal cell.....*Polythrena* (25).
 24. Light gray or white; apex marked, humeral cell smaller, normal.

Euchæca (33).

25. Abdomen with small dorsal tufts, usually black, front more or less extended below, often into a triangular point; wings similarly marked, with fine wave-lines **Eupithecia**, **Eucymatoge** and **Orthonama** (36).
 25. Abdomen smooth scaled, without mid-dorsal black dots, though sometimes with subdorsal ones; clypeus not pointed.....26
 26. Wings tawny orange; a single small accessory cell.....**Loxofidonia** (34).
 26. Wings not tawny, usually two acc. cells.....27
 27. Hind wings slightly angulate at M_3 and excavate above..**Percnoptilota** (35).
 27. Hind wings with evenly wavy or rounded margin.

Hydriomena (series II) (37) and **Lobophora** in part (12).

NOTES.

1. *Diastichtis julia* is very closely related to *loricaria* of Europe, which has a female with very short wings; if ours is similar it will run out here. *D. bicolorata*, which is extremely close to it, however, has nearly fully developed wings.

2. *Alsophila*, *Palcacrita* and *Erannis* in this country. Both larval and adult characters associate *Palcacrita* with the Ennominae rather than the Ctenochrominae (Monocteniinae).

3. The South American genus *Coronidia*, which appears in Kirby's list as a Uraniid is undoubtedly a geometer, as shown by both venation and tympanum. The clubbed antennae and lack of a frenulum would associate it with the Hydriomeninae, which it also resembles in markings, and from which it is undoubtedly derived; as the costal venation of both wings is aberrant, I let it stand by itself. All the species I have seen have the hind wings lobed or tailed on M_3 .

4. The name Acidaliinae cannot stand, as *Acidalia* is preoccupied in the butterflies. *Sterrhina* is unsatisfactory, as *Sterrrha* has lately been restricted to the *sacraria* group which violate the definition of the subfamily and only very doubtfully belong to it; but it seems to have priority.

The Cylopodidae, as sometimes used, is a composite of yellow species of this subfamily and Dioptidae: the latter are easily distinguished by the lack of tympanum and differently shaped abdomen, the straight Sc of hind wing not connected with R, and fully developed male hind legs, besides the usually longer upturned palpi and frequent preservation of part of 1st A in the fore wing. In a similar way the more typical Dioptidae have often been confused with translucent-winged Ennominae.

5. In *Palcacrita* Sc and R of the hind wing are often more or

less fused, and M_2 more or less completely preserved. It may be recognized as an Ennomid by its spined abdomen.

6. Dominantly South American. *Sparta* from Europe is closely related, but has rudimentary tongue and palpi and even more reduced hind wings.

7. The typical group from Europe is extremely close to *Lobophora*, differing from our *limitata* group only in the separation of Sc and R in the male. *Veritata* Pears. is aberrant in its squarer, more thinly scaled wings. The genus is also in South America.

A considerable group of exotic genera will run out here. *Mysticoptera* Meyr. has four spurs and a large folded lobe in the male. In *Siona* (*Schizostege*) the modification on the inner margin is a small pocket, as in *Carsia* to which it is related. The *Rhopalodes* group, of South America, have antennæ distinctly, though slightly, swollen toward the tip; *Rhopalodes* is otherwise like *Trichopteryx*; *Tomopteryx* has an acute fore wing with the outer margin bent at the middle, etc., an outlier is *Tatosoma* of Australasia, which has the same antennæ, a very long abdomen, the lobe spirally coiled, and in the species seen, three spurs on the hind tibia. *Remodes* has more complex structures on the hind wing, and the rare combination of very long palpi and smooth front. For other genera see the "Moths of India."

8. *Nannia morensata* Hulst appears to be *H. (Lygranoa) fusca* of Japan with incorrect locality, but as the type is a female I cannot be sure, it could be a suffused specimen of *refusata*.

Male antennæ bipunctinate, head and wing characters intermediate (group *Lygranoa*) *fusca* (Asia).

Male antennæ fasciculate.

Hind wing with inner margin bent over at base only, forming a rudimentary pocket suggesting *Carsia*, with a hyaline patch farther out, crossed by the root of Cu_1 , and enclosed by the rudimentary root of Cu_2 ; Cu_1 turning at right angles and running to anal angle. Fringe of hair below M_2 slight beyond cell; M_1 and M_2 close together at origin. Female with front as wide as eyes (group *Nannia*) *refusata*.

Hind wing with a folded lobe at anal angle also, supported by the distinct rudiment of Cu_2 , which runs to anal angle as well as Cu_1 ,—the area crossed by Cu_1 recognizable, but hyaline only in badly rubbed material. M_1 and M_2 widely separate, female with larger eyes (group *Heterophleps*) *triguttata*.

Other types of structure doubtless occur in Asia where the genus is better known as *Dysethia*.

9. Hind tibiae with all spurs.

Costa arched, Sc and R of hind wing normal *Eucestia* (= *Chesias*).

rufata and **spartiata** (Eur.).

Middle of costa straight, habitus of *Carsia*, Sc and R normal (*Anaitis*).

rotundata (Am.) **plagiata** etc. (Eur.).

Hind tibiae with end-spurs only, costa nearly straight (*Scelidacantha*).

triseriata and **virginata**.

Palaoctenis from N. Africa is similar with unipectinate antennæ.

10. A development of the gibbocostata group of *Stamnodes*, known to me only from western North America; *marmorata*, *odonata*, and *animata*.

11. Closely related to the typical group of *Hydriomena* in both general structure and genitalia.

12. In this variable mass practically every species has some distinctive structure, often confined to one sex, and there is some individual variation of structure, with the result that a large number of genera have been made. The American and principal Palæarctic species may be analyzed as follows:

Palpi long, beaklike; hind tibiae with end-spurs only, with hair-pencil; Cu₂ of male hind wing well-developed, lobe small (except in *Episauris* from N. Africa) fore wing very large with a fine crisp pattern, most often with green.

Hind wing with R and M₁ stalked in male (*Episauris* Rbl.).

kiliani (Canaries and Madeira).

R and M₁ separate in male only, fore wing marked with green (*Acasis* Dup., *Agia* Hulst.).....**viretata** (Eur.), **viridata** (**eborata** Hulst.).

R and M₁ separate in male, approximate in female.....**appensata** (Eur.).
Palpi slightly exceeding front or short.

Tibiae with end-spurs only, lobe small, wings not very broad, Cu₂ developed in male.

Hind wings with R and M₁ well separated at origin in both sexes.

Hind tibiae with hair-pencil (*Nyctobia*).

limitata, **angulinea**, **nigroangulata**.

No hair-pencil (*Cladara*)**atroliturata**.

Hind wings with R and M₁ stalked in both sexes, fore wings a little broader; with hair-pencil.....**sertata** (Eur.).

Tibiae with all spurs, R and M₁ moderately separate in male, stalked or approximate in female, Cu₂ of male rudimentary.

Lobe very large, free at tip; with hair-pencil (*Lobophora*).

halterata (Eur.). **delogramma** (Austral.).

Lobe very small, truncate.

Hair-pencil on hind tibia (*Oulobophora* Stgr., *Philopsia* Hulst.).

internata and **externata** (Eur.), **nivigerata**.

No hair-pencil (*Taliedege*).

montanata, *magnoliatoidea*, *canavestita*.

Mysticoptera is similar to the typical group of *Lobophora* but with a single accessory cell (Europe), *Trichopterygia* has a very large single accessory cell, R. and M₁ stalked even in the male, and translucent hind wings.

There are a number of exotic genera connecting this series with the preceding genera on the one hand, and with the central *Cœnocalpe* group of *Hydriomena* on the other.

Microloba (*Tyloptera* n. b. l.), from eastern Asia has 2/3 pectinate antennæ in both sexes, one small acc. cell, lobe much reduced and both cubitals apparently lost, as in *Heterophleps*. The position of the discal dot shows that it is a posterior vein, and not R that is lost (*M. bella*).

In *Crocypus* (S. Am.) the lobe is slender, bearing long hair, mdcv of hind wing long and bent, front and wing-vestiture as in *Operophtera* (*C. perlucidaria*).

Eratcina is a large genus from South America, forming the connection between *Hydriomena* and *Coronidia*, except for the male structures. Frenulum absent, mdcv. bent, often extremely long, one small accessory cell; hind wing typically with a large lobe, folded under in the male, which becomes reduced to a slight thickening and crimping of the inner margin in species approaching *Trochiodes*. The following species were seen—some of which may really be merely females of others as the sexes are strikingly different in wing form and have often been described as distinct: *leptocircata*, *herbertina*, *drucei*, *undulata*, *zoraida*, *staudingeri*, *rosina*, *sinuata*, *delineata*, *pusaria*, *aroma*, *cometaria*, *lineata*, *artabates*, *flaventia*, *amazonia* (v. *immaculata*), *artemis*, *trisectistrigata*, *rhessa*, *linda*, *catenata*, *hyaloplaga*, *rogersi*, *siliquata*, *dilectaria*, *specularia*, *radiaria*, *substriata*, *cynthia*, *carulcopicta*, *obscura*, *cornelia*, *proana*, *inexpectata*, *masura*, *sub-sagittata*, and *peloria*.

Trochiodes is practically like the last group of *Eratcina*, but the anal angle of the hind wing is shortened and there are two acc. cells, some species have a hair-tuft in the cell of the fore wing. *Pohliata*, *lithosiata*, *cyris*, *cachara*, *prusa* and *pramenca* were seen, all from S. Am.

Rhopalista and *Hammaptera* have more or less the appearance of

Lobophora but the inner margin is merely folded and heavily clothed with hair, some species of the latter grading into *Hydriomena*. *Rhopalista* has a heavy tuft at anal angle above and mdcv. straight but long; the species seen are green and orange. *Hammaptera* normally looks quite like the central group of *Hydriomena*, but normally the discocellular is quite weak, and the apparently thickened inner margin of the hind wing is distinctive. The group with nearly hyaline hind wings are more nearly normal, with long bent mdcv., but the thickened inner margin contrasts strongly.

In *Amygdalopteryx*, as typified by *dulciferata* and *senguera* the pattern is like *Rhopalista*, but the thickened inner margin is obliquely truncate.

Spiloctenia is *Trochiodes* with pectinate male antennæ. (*S. ocellata*, S. Am.).

In *Mclitulias* from Australasia, the sex-scaling instead of being confined to the inner margin lies on the flat upper surface of the wing, and tends to be restricted to the costal area. In all these latter genera, beginning with the latter group of *Erateina* the anal is well developed.

13. *C. paludata* and *imbutata*; the latter is represented by specimens from Newfoundland in the Pearsall collection, and easily recognized by its rose shading. Apparently each locality has its recognizable variety, some of which may be worthy of names; *boreata* Pack, applies to the White Mountain form, which is dull and smooth looking, with well contrasted t. a. and t. p. fasciæ.

14. *O. danbyi* is transitional to *Epirrita* in structure and markings. Female wingless, one acc. cell (*Rachela*)...**bruceata**, **occidentalis**, **hyberborea**. Female wings about as long as thorax.

Wings more heavily scaled, tongue shorter than head, normally two acc. cells (*Paraptera*)**danbyi**

Wings very thinly scaled, tongue longer than head, one acc. cell (*Operoptera*)**boreata**, **brumata** (Europe).

Hydriomena (?) *gratulata* will run out here but is distinguished by its normal palpi, frenulum and scaling.

15. Practically synonymous with *Cataclysmæ* of Europe which has simple antennæ. Typical *Zenophleps* intermediate between our species occur in India. *Acodia* of Australasia is marked much like our *obscurata*, but the accessory cell is lost.

Mdev. of hind wing bent, though short, wings acute, acc. c. at end of discal cell.
lignicolorata.

Mdev. of hind wing straight, wings rounded, acc. cell before end of discal cell.
obscurata.

16. To judge by the South American fauna *Eudule* is one of a considerable group derived from *Stamnodes* or a closely similar form, in fact the genera seem to intergrade through *Ænotrus*. In some of these the wings are practically normally scaled, but may be distinguished from *Stamnodes*, etc., by the characteristic single large accessory cell. Typical *Eudule* has small hind wings and the abdomen extending well beyond them. Typical examples are *E. pulchricolora*, *venata* and *invaria* (of which *nigricosta* and our species *unigolor* appear to be synonyms). *E. helveta* is transitional to group *Euphanessa*, whose pattern it shows. *Mennis* is a further exaggeration in the same direction where the body exceeds the wings by a fourth its length (*bimacula*, *ficulnea*, *cythna*, *una*, *fidentia*, *bipennis*, *leopardina*, *orsilochia* and *sceata* were seen). These two groups have a distinct tendency to enter mimicking associations. Our eastern species (*mendica* and *meridiana*), with short bodies and ample hind wings belong to group *Euphanessa*, from which group *Leptidule*, of South America differs in the strongly tufted fore wing with distorted venation (*L. medea*, *dulcifera*).

17. There is a strong tendency in all parts of the world for arctic-alpine species of all families to show these characters. In South America such forms have developed from *Stamnodes*, and from its black-marked variant, *Heterusia*; in North America *Euchæa* shows the same tendency, for from genitalic characters this is where "*Hydriomena*" *rubrosuffusata* belongs. It is also very doubtful if our species of *Trichochlamys* are really close relatives. *Hagnagora* (*catagrammina* and *buckleyi* of South America) is easily recognized by its much enlarged tympanic opening and blue-marked hind wing. *Bombia* also has hairy vestiture and simple antennæ; both wings are broad and somewhat lobed at middle of outer margin, and there is a single large acc. cell connected with Sc. *Heterusia* is the South American representative of *Stamnodes* distinguished by the larger area of black, the usually squarer wings, and the strong tendency to develop frontal hair. Our *S. albida* is in all except its lighter coloring, a *Heterusia*. *H. edmondsii* of Chili carries the hairiness to the extreme.

These last three genera differ from *Psychophora* and *Trichochlamys* in the long bent mdev. of the hind wing.

18. This is undoubtedly *Psychophora* of Curtis; a good series from the Pribiloff Islands which I have seen, agrees exactly with his figures. *Asaphodes* Meyrick is a synonym. The antennal differences are unimportant, and I believe both *Trichochlamys*, and *Dasyuris* Guenée (which has intermediate antennæ) could be sunk to *Psychophora*. *Notorcas* Meyr. from New Zealand is distinctly more hairy. *Stratonice* has a single accessory cell and more plumose antennæ.

Lythria, of Europe, is a parallel development from the group connecting the Hydriomeninæ and Sterrhinæ, it differs in the single small acc. cell not reaching the end of the discal cell.

19. The costal venation and appearance, as well as the hind tibia would place *Synomila* in the Sterrhinæ, but as the fusion of Sc and R of the hind wing is a little long it is also mentioned here.

20. *Minuta* and *remorata*, of our species, belong here; the genus appears to be nearly world-wide but is obscure. It intergrades with *Nasusina*, some of which have the upper tibial spurs much reduced.

21. Hind-tibial spurs very much reduced in *N. mellisa*. The front is bulging as a whole in *N. inferior*, but usually is strongly oblique and extended below, but does not run to a point as so often in *Eupithecia*.

22. I suspect this genus is confined to the Old World, where it is the center of a considerable group (*Elvia*, *Pasiphila*, *Phrissogonus*, etc.). *C. inconspicua* Hulst is an Ennomid.

23. This becomes *Hydria* if the Tentamen be accepted. *Eucosmia* is the same. *Philereme* (*Scotosia*) is hardly distinct but lacks the sexual tufting and is more deeply scalloped; it differs from *Triphosa* in the enlarged tufted claspers. We have no species, *californiata* is a *Triphosa*, though with rather distinct genitalia, and the others listed by Hulst are Hydriomenas (in the broad sense) of various groups. Our single species of *Calocalpe* may have to be separated from the European, as it is social and confined to wild cherry, while the latter is reported as solitary on willow. No differences have been found either in structure or markings of the imago.

24. *Coryphista* is composed of *meadii* with its brown variety *badiaria*, *certata*, etc., from Europe and *affirmata* with its brown variety *bicolor* in South America. *Progrcssata* from the West Indies may go here, it certainly is not the Californian *Triphosa*.

25. Prout in the "Macrolepidoptera of the World" divides this group as follows, but the differences are not very wide. The whole group has been generally called *Polythrena* in the old world.

Middle discocellular of hind wing angulate.

One acc. cell, no pencil on hind wing; black and orange (*Polythrena*).
coloraria, *miegata*, *angularia* (Asia).

Two acc. cells, a pencil on upper side of hind wing as well as under side of fore wing; black and white (*Trichobaptia*).....*exsecuta* (Asia).

Middle discocellular short and straight, one pencil only; black and white (*Trichodezia*)*albovittata*, *californiata*, *habershaueri*, *kindermanni*.

The typical group makes the transition to *Eustroma*.

26. True *Eustroma*, characterized by Prout as having the pencil of hairs arising below A, and the apex of the wings more rounded, does not appear to occur in this country. *Atrocolorata* has the proper type of markings, but has no trace of the hair-pencil. *Photoscotosia* (*Lasiogma*) approaches our *nubilata*, but seems to differ in the short straight mdcv. *Neolexia* and *Phylacc* are parallel developments from slightly different groups of *Lygris*; *Phylacc* has the hair-pencil but it is not very strong. Our species may be grouped as follows:

Male antennæ bipectinate.

Hair pencil normal, markings of *triangulatum* (*Neolexia*).....*xylina*.

Hair pencil weak, markings of *populata* group (*Phylacc*).....*luteolata*.

Male antennæ laminate or more or less serrate; pencil normal (*Lygris*).

Pencil massive, a third the length of the inner margin or more, habitus of Oriental species of *Eustroma*.....*cunigerata*.

Pencil moderate in size.....*triangulata* (*prunata* auct.), *destinata*.

(Is this distinct from the last?), *testata*, *remotata*, *populata*, *diversilineata* and the European *prunata*, *pyropata*, *associata*, etc.

Male antennæ laminate, pencil forming a long black streak.....*nubilata*.

The last group is possibly transitional to *Photoscotosia*.

27. *T. dubitata* does not occur here; our species with strikingly distinct genitalia, but almost identical markings is *indubitata* Grt. *Progressata* Walker seems to be a West Indian *Coryphista*, the western species must become *pustularia*, and its smooth black form is nameless. The difference between it and the eastern form is slight. *Californiata* (*packardata* Gross.) seems to come here, but is a strikingly distinct species.

28. Seems to differ from *Hydriomena* only in the male antennæ, certainly not sufficient to base a subfamily on. The wing-form and pattern agrees with *Ortholitha*.

29. *Enotrus* is not really distinct from *Stamnodes*, but the coloring is different. The type species, *dispar*, has much more red than ours, and superficially looks like some *Eudules*. *Emplocia* cannot be used as its type is an Ennomid.

30. *Canocalpe* in part of Hulst, but differing in the smooth front, shorter palpi and in the simple pattern of the upper side. The two genera perhaps represent the most primitive of living Hydrimeninae. So far as examined the genitalia are also closely similar. In the more alpine species the head and body tend to become more hairy, especially in the closely related South American genus *Heterusia*, and the genus becomes structurally identical with *Hydriomena*. *Lisopsis* is based mainly on the characteristic pattern, and *fervifactaria*, of our species, might be transferred to it. The species of *Xanthorhoë* (*petrophora*) with mdcv. long and bent also show the pattern of *Stamnodes*, and I believe, should be transferred to it in spite of their pectinate antennæ; they are *volucer*, *costimacula* and *rubrosuffusa* of our list, *sistenata* and *jaspata* of the Neotropical, and, I think, *nephelias* Meyr., of New Zealand, if I have it rightly identified.

Callippia is similar, but expands over two inches, the patagia are densely hairy, and there is hair on the palpi and face. *Cophocerotis* is *Stamnodes* with unipectinate antennæ; both from South America.

31. Close both to *Venusia* and to *Operophtera*, group Paraptera: the European species *verberata* appears to belong here, making the connection with *Venusia*.

32. I should separate *Venusia* from *Euchocca* by the course of mdcv. of the hind wing rather than the male antennæ, as it correlates much better with the markings and genitalia; both types occur in Europe with two accessory cells, *verberata*, mentioned above with a long bent discocellular, and the genus *Asthena* with short nearly straight ones. Some of the European species seem to grade into typical *Hydriomena*.

Venusia in this sense will separate into three groups by antennal characters: (1) *Venusia* proper, with pectinate antennæ, contains *V. cambrica*; (2) *Nomenia*, with the laminations long and narrow, those of successive segments spaced apart from each other, includes *unipecta* (*12-lineata*), and *secunda*; and (3) a group containing *compertaria*, *pearsalli* (*12-lineata*) in this country, *blomeri* and *decolorata* in Europe and several Indian species. I suspect the name *Hippolyte*

Meyrick is available for this group, but Meyrick fails to mention the middle discocellular veins and I have seen no material of *H. rubropunctaria*. *Baptia tibiale*, generally associated with *Polythrena* on account of its markings will also run here, but its bluntly rounded wings and black ground-color are distinctive. I would hardly dare venture a guess as to its true position, but it has always been associated with the *Polythrenas*.

33. *Asthena* has two accessory cells and is general in the old world. *Minoa* differs in its yellow color, and herbaceous food-plant, but there seems no tangible difference in structure.

34. A variant of *Xanthorhoë*, with which it is connected by an extensive Australasian group ranging into Europe.

35. *Latirupta* and *fluviata* are congeneric, in fact closely similar, though the sexual difference is less striking in the former. I should also include *H. excrucata*. *Multiferata* lacks the characteristic wing form and is quite isolated. It lacks coremata, and so would go better here than in the *Xanthorhoë* group of *Hydriomena*. There seem to be close relatives in South America. The genus is world-wide, especially *P. fluviata*, and species connecting it with *Hydriomena* occur in both hemispheres.

36. The typical species of these three genera are distinct enough but there is a complete series of intergrades. *Orthonama* has equal accessory cells, scalloped hind wings and a rather crowded radial system in the fore wing. *Vitalbata*, *intestinata*, *gillettei* and *rectilineata* are typical, but *classicata*, *vanconverensis* and *græfi* are *Eupithecias* except for the two subequal accessory cells. In typical *Eucymatoge* the first accessory cell is minute, perhaps subject to individual variation; our species are *anticaria* and *tennata*. *Eupithecia* has a single accessory cell, evenly rounded wings, radial system so spaced that the distance from the costal edge to the stem of R_3 and $_4$ is much wider than the ordinary distance between two veins in the lower part of the wing, and the clypeus is often extended in a point as in the common eastern *E. miserulata*.

I believe the dorsal tufts are constant in perfectly fresh specimens and outside of India the similarly marked wings with fine wave-lines are characteristic. The tufts are usually black, but white and concolorous in *E. cretacea*. Superficially *H. stellata* is similar, but the black dots on the body are subdorsal.

Coremata of the type that occur in the *Xanthorhoë* group are absent, but there are usually small ones nearer the tip of the abdomen.

37. There remains a considerable mass of species with what may be called the typical Hydriomenid structure, without strong secondary sexual characters except in the male antennæ. Below I have grouped our species, so far as I have seen them, as well as a few of the Europeans, on what characters I could find. Those from the antennæ are generally clean-cut but often separate very closely related species, and the same is true of the single or double accessory cell. The genitalic characters are striking and seem to form natural groups, but I have seen only the eastern species as a rule. The long and bent, or short and straight middle discocellular of the hind wing is widely useful, but in *cæsiata* and *aurata* it separates closely related species; in fact our *aurata* appears in the list as *cæsiata*, which seems really confined to the old world. Coremata or membranous eversible organs near the end of the abdomen are general in the group with short middle discocellular, but are rudimentary in *silaceata*, which is also aberrant in markings, and belongs to a mainly Indian group whose genitalia have not been examined.

Of the genera which would run out here the following are the most definable:

Heterusia, of South America, has simple markings above and complex below as in *Stamnodes*, in part of the species the front is smooth and the structure becomes like *Stamnodes*.

Eurhinosca: fore wing broad, subfalcate, one acc. cell. Male antennæ strongly serrate and fasciculate; pale yellow (*flavaria* only).

Ortholitha: Male antennæ pectinate or rarely subpectinate, mdcv. straight, short; moth brown with characteristic markings similar to *Monotaxis*, which it also resembles in having the costa of the hind wing much longer than the inner edge of the fore wing (Palæarctic).

Oligopleura: fore wing produced at apex and sometimes at R_s , in that case truncate at tip, also at M_3 and concave between, hind wing with M_3 and Cu_1 stalked, or in macrocephala united (South America).

Anchiphyllia: Hind wing strongly falcate on M_1 , male abdomen with side-tufts, otherwise like *Ersephila*, markings of *Monotaxis* (S. America).

Priapodes: Second joint of palpus very long and cylindrical, closely scaled, third joint short; fore legs very long, folded on sides of neck

in repose. Apparently related to typical *Hydriomena* (South America).

Percnoptilota (?): Costa arched, apex marked, antennæ laminate, mdcv. short; 2 acc. cells; fore wing marked with fine striations; no coremata **multiferata**.

Rhodometra (*Sterrha*): One small accessory cell not reaching end of discal cell, as in the Sterrhinæ (Europe, etc.).

Analysis of *Hydriomena* as restricted above:

1. Middle discocellular vein of hind wing bent sharply, and longer than lower discocellular, or rarely about as long, but markedly bent (*aurata* Pack.).

SERIES I.

2. Male antennæ doubly bipectinate, §1 **firmata** (Europe).

2. With broad oblique pectinations, plumose, §2 **turbata** (Europe).

2. Moderate normal pectinations, not extremely oblique.

3. Markings of fine lines as in *Ortholitha*, §3 (*Larentia*).

clavaria Haw. (Europe).

3. Markings of widely spaced lines as in typical *Hydriomena*, §4 (*Carptina*) **hydriomeniata**.

2. Antennæ spatulate-subpectinate, §5 **vespertina**, **aqueata** (Europe).

2. Antennæ heavily serrate and fasciculate.

3. Otherwise like typical *Hydriomena*, with R_2 short, anal angle rounded over, etc., §6 (*Ersephila*) **grandipennis**, **indistincta**.

3. Wings short with marked anal angle, one acc. cell.... **Eurhinosea**.

2. Male antennæ laminate, ciliate or nearly simple.

3. One acc. cell, palpi fairly long and beaklike.

4. Male antennæ nearly simple and heavily but very shortly ciliate; anal angle of fore wings not distinctly marked; gray without strongly contrasting markings, §7 **georgii**.

4. Male antennæ deeply laminate (prismatic); anal angle intermediate, markings strongly contrasting, deep brown, suggesting *Eustroma reticulata*, §8 **atrocolorata**.

4. Male antennæ laminate, anal angle well marked, black and white species (except for suffused arctic specimens), §9 (*Rheumaptera*) **hastata**.

3. Two acc. cells.

4. Inner edge of fore wing generally much longer than outer, the anal angle not well-marked, palpi often long and beak-like, R_2 generally short.

5. Male antennæ deeply prismatic.

6. Uncus simple; with a heavy hook on inner side of clasper; small fragile species generally associated with conifers, §10 (*Thera*).

juniperata, **variata**, **cupressata** (Europe), **simulata** (Holarctic), **contracta** (Am.).

6. Uncus forked, or less often truncate; moths generally heavier, very often marked with green, or with transverse gray bands of moderate width; palpi of various lengths §11 (*Hydriomena*).

furcata (with *sordidata*, *5-fasciata*, etc.), *reflata*, *abacta*, *nubilofasciata*, *cochiseata*, *irata*, *manzanita*, *autumnalis*, *transfigurata*, *californiata*, *banahvarata*, *glenwoodata*, *magnificata*, *ruberata*, *similaris*, etc., from N. Am. and others from Europe and S. Am.

6. Genitalia normal, with slender uncus, palpi barely exceeding front, antennæ not quite so broad, t.a. and p.m. areas normally with yellow or brown patches or bands §12.

hersiata, *formosa*, *ethela*, *brunneata*, *acuata*?¹

5. Male antennæ only slightly prismatic at base, uncus simple, no hook on clasper, median area broadly dark or with a central white patch; palpi long and beaklike §13.

✓ *truncata*, *immanata*, *walkerata*, *glacialis*, *patulata*, *occidentata*, *hulstata*?, *mancipata*?

5. Male antennæ moderately prismatic and subserrate, palpi long, R₂ long, moths approaching *Lygris* §14.

dotata, *fulvata*, etc. (Europe).

4. Inner edge of fore wing hardly longer than outer, the anal angle generally well-marked, palpi generally short, R₂ long.

5. Fore wing subfalcate, hind wing a little irregularly scalloped, §15 (*Strepsizuga*). *aberrans*, *gavara*, etc. (S. Am.).

5. Fore wing not subfalcate, hind wing even or evenly wavy.

6. Scales of fore wing very narrow, straplike, usually with yellow scales, and with blurred markings (*Entephria*).

7. Mdev. short, though bent, §16.

aurata Pack.,¹ *multivagata*, *lagganata*, *takuata* (N. Am.), *flavicinctaria*, *cyanata* and *tophaceata* (Europe).

7. Mdev. long, normal for the group, §17.

cæsiata (Europe).

6. Scaling normal, mdev. in our species normal, long.

¹ *Actuata* has the smooth front and short palpi of *Venusia*, but is distinct from all our species in markings and in the two acc. cells. I am unwilling to move it without studying the male genitalia.

² *Cæsiata* apparently does not occur in this country, our species is *aurata* Pack., which preoccupies *aurata* Grote; as the latter comes in a markedly different group, which is likely to be considered a good genus I do not propose a new name for it.

7. Olivaceous brown and white, male antennæ prismatic, §18.

alchemillata, affinitata, minorata, etc. (Europe).

7. Normally black, blue-gray and white, wings fragile, the outer margin nearly even.

8. Eye smallish, M_2 of fore wing arising well below middle of cell, mdev. long and bent in both wings, §19.....**gratulata**.

8. Eye full normal size, M_2 on fore wing from above middle of cell. ldev perceptibly bent, §20 (*Mesoleuca*)**ruficiliata**.
and its old-world representative.

albiciliata.

7. Small light species with very long palpi, very long radial branches and usually with a dark median band and a triangular patch below the apex, §21 (*Psaliodes* Guen.).

interrupta Grossbeck and many neotropicals.

7. Normally dull fuscous, the hind wing slightly bent at M_3 , wings heavier, §22 (*Anticlea*).

badiata (Europe), etc., **vasaliata**.

7. Fore wing with fine wave-markings and often yellow scaling, hind wing very often yellow, §23 (*Spargania* Guen.).

aurata and **magnoliata**; **flavolimbaria** of S. America, etc. (**pernotata**, **tæniata**, **parinotata**, **alaskæ**, **occidens**, **oxygramma**, **costiguttata**, **custodiata**, **carnata**, **polygrammata** and **lapidata** of Europe, the type of *Cænocalpe* Hubn., approach this group more or less closely).

1. Mdev. of hind wing short and straight, ldev. often long and oblique; all the species examined with eversible glands on the male abdomen (*coremata*), which are rudimentary in *silaceata*; generally with wings normal in form, with inner margin but little longer than outer, well marked anal angle and even or slightly wavy outer margins, normally with a dark medial area of moderate width (*Xanthorhoë* in the broad sense) **SERIES II.**

2. One accessory cell which is usually more or less abnormal in form.

3. Male antennæ plumose, vestiture largely hairy, accessory cell small, normal (*Loxofdonia*)¹ **acidaliata**.

3. Male antennæ pectinate, fore wing with a lobe near base of inner margin, hind wing exceptionally short, §24. **triangularia** (exotic).

3. Male antennæ nearly simple.

³ This may be a synonym of one of Meyerick's New Zealand genera unknown to me; as described some must come very close.

4. Brown, the markings closely similar to *Percnoptilota*, §25.
mirabilata, medeifascia.
4. Black or gray and white, the hind wing usually marked about like the fore wing or black.
(**Rheumaptera** Hulst, not of Hübner).
5. Eyes smallish, palpi and frontal tuft short, §26.
luctuata (**tristata** of American workers), **tristata** (probably not American).
5. Eyes, palpi and frontal tuft normal, §27.
lugubrata (**luctuata** of American workers), **sociata** (**unangulata** of Packard and others).
4. Eyes smallish, fore wing dark, hind wing yellow; genitalia of *Euchæa*, §28 **Euchæa** (?) **rubrosuffusata.**
2. Two accessory cells (occasionally a single large triangular one as an aberration).
3. Male antennæ bipectinate.
 4. Costal edge of hind wing notably longer than inner edge of fore wing **Ortholitha** (Europe).
 4. Wings proportionate, §29 (*Xanthorhoë* Hübner, *Petrophora* of the Tentamen; *Larentia* and *Epyaxa* of Meyrick's New Zealand paper, but not *Larentia* as restricted by Curtis).
incursata, montanata, munitata, borealis, nemorella, convallaria, algidata, defensaria, californiata, labradoriensis, pontiaria, etc., iduata (which is **abrasaria** of American workers).
3. Male antennæ very shortly doubly bipectinate and fasciculate.
 4. Pectinations equal and stout, §30 **abrasaria.**
 4. Alternate pectinations rudimentary, §31 **fluctuata.**
3. Male antennæ fasciculate and somewhat serrate.¹
 4. Wings similar in markings, §32.
stellata (**sitellata** is a misprint).
 4. Hind wings simply marked, §33.
designata, intermediata and various exotics.
3. Male antennæ simple or nearly so, not fasciculate or deeply laminate.
 4. Hind wings, and often fore wings yellow, §34.
A large old-world group.
 4. Fore wings with a more or less contrasting dark median area, hind wings whitish.
 5. Coremata rudimentary, §35 **silaceata**
 5. Coremata large, §36.
lacustrata, unangulata (probably not American), etc.
3. Male antennæ more deeply prismatic.
 4. Larger, dark brown, markings about as in *Triphosa*, outer margin wavy; coremata doubtful.

¹ This is *Gypsochroa* of Hulst, but not of Hübner.

5. Palpi close-scaled and closely upturned to middle of front, the third joint sometimes porrect in death; scales rather narrow as in *Entephria*, with obscure wave-markings on fore wing, §37.....*indefinata*.
5. Palpi moderate, rough, beaklike, hind wings more distinctly scalloped, scales normal, §38.
- neomexicana*, *australis*, etc.²
4. Small, brown with many nearly straight transverse lines, outer margins even; no coremata.

Percnoptilota (?) *multiferata*.

The following papers contain keys to the genera of *Hydriomeninæ*:

- MEYRICK, E.: A monograph of the New Zealand Geometrina, Trans. N. Z. Institute, 16, 49, 1883. This is the fundamental paper on which our present classification is based.
- MEYRICK, E.: Revision of Australian Lepidoptera, IV, Proc. Linn. Soc. New South Wales (2), 5, 791, 1890.
- MEYRICK, E.: On the Classification of the Geometrina of the European Fauna, Trans. Ent. Soc. Lond., 1892 (1), 53, 1892.
- HAMPSON, G. F.: The Fauna of British India, Moths, III, 329, 1895.
- HULST, G. D.: A classification of the Geometrina of North America, Trans. Am. Ent. Soc., 23, 245, 1896.

NOTES ON OSTEN SACKEN'S GROUP "PÆCILANTHRAX," WITH DESCRIPTIONS OF NEW SPECIES.

BY FRANK R. COLE,

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The species in this group of Bombyliidæ are very difficult of characterization and it may be that some of the described species are local varieties or races. I have had a good series of most of the species to work with. Mr. Knab loaned the National Museum collection in this group which made up a large part of my material, and Mr. Banks and Mr. Walton have loaned me specimens. In the preparation of this paper I am greatly indebted to Mr. Banks for compar-

⁵ *Scotosia gobiata* of New Zealand would run here and may really be related.

ing a number of specimens with the types in the Museum of Comparative Zoology at Cambridge, and for many suggestions in separating the different species. Mr. J. M. Aldrich kindly sent me notes on the specimens of this group in his collection. There are several specimens in the National Museum which I left unnamed, their position being at present uncertain, on account of the lack of material.

Osten Sacken was I believe the first to call attention to the related forms of Anthrax grouped around *A. halcyon* Say, the first instance being in Western Diptera, p. 239. In the Biologia (Diptera, Vol. 1) he defines this group and refers the following species to it: *halcyon*, *arctusa*, *alpha*, *pocilogaster*, *ceyx*, *flaviceps*, and *fuliginosa*. Osten Sacken gives the following distinguishing characters for these species: "the Exoprosopa-like front legs (short; tibiae without spinules; tarsi very gently tapering, with rather indistinctly marked joints, and a delicate pubescence of erect hairs on both sides; ungues very small); the face conically produced, the proboscis not projecting beyond the oral margin; the third joint of the antennae in the shape of an irregular cone, gradually tapering off into a long point (but not a style). The coloring of the wings characteristic, brown, with a clear space at the apex, traversed by the more or less clouded 'S'-shaped anterior branch of the third vein; a clear space in the discal cell, more or less connected with the posterior margin; supernumerary cross-veins often occur, bisecting either the third posterior or the second submarginal cell; a stump of a vein in the third posterior cell is very often present. Another peculiarity of this group is that the impressed line which, in most species of *Anthrax*, issues from the emargination of the occipital orbit, and crosses a portion of the eye, is very short and almost obsolete here."

Osten Sacken gives this group the name "Pœcilanthrax." As to structural characters, there is practically no variation, although size may prove a good character. The coloring and pattern of the wings varies in specimens of the same species, but the general design is constant and characteristic of the species. The small stumps of veins occurring quite often are variable, as are supernumerary cross-veins. Very little can be added to Osten Sacken's characterization of "Pœcilanthrax." The species are all comparatively large and all the species known have black pile on the sides of the abdomen, usually in tufts

near the posterior margins of the segments. This group is known only from America. The habits and early stages of species are not known. The life history is no doubt similar to that of other species of *Anthrax*.

Anthrax californicus new species (fig. 2).

This species resembles *A. alpha*. The general color is grayish black, with a blue tinge on the thorax. There is a round red spot on the lateral margin of both the second and third segments. All the segments except the first have black pile on the posterior border. With the exception of the posterior border the segments are covered with whitish pile and tomentum. The pile on the sides of the abdomen is quite long and bushy (see fig. 3). Scutellum reddish brown, the base black. Occiput black, with sparse white tomentum. Short black pile on frons, which continues below base of antennæ. First joint of antennæ reddish, the second and third black (see fig. 14). Base of front femora blackish, also the tarsi and tips and inner sides of tibiæ. The first three segments of the venter reddish, the rest black. Pile of thorax pale yellow, the spines yellow. Pleuræ black, the pile whitish. Wing markings very much as in *alpha*, the light spaces smoky hyaline. No supernumerary cross vein. Very short stump of a vein in third posterior cell, arising near second posterior cell.

Type.—U. S. N. M., Cat. No. 20737—Four specimens.

Habitat.—East Highlands, Cal., Sept. 21, 1914.

A specimen from Reno, Nev., Sept. 2, 1916 (H. G. Dyar), has more white tomentum on the dorsum of the abdomen. There is less white pile on the abdomen and no red spots on the second and third segments. The legs are all blackish, except the knees, the femora and tibiæ with white tomentum. One specimen from Las Cruces, N. M., Sept. 27 (Townsend).

Anthrax halcyon Say (fig. 2).

Anthrax alcyon Say, Complete Works, Vol. 1, p. 252.

"Wings brown, a hyaline spot near the middle, another at the tip in which are two curved brown lines.

"Inhabits Northwest Territory.

"Body black, with pale fulvous hair; head yellowish-white, hairs above the antennæ black; tip of the hypostoma prominent, and with rigid black hairs; antennæ black, basal joint yellowish with black hairs; vertex black; occiput with a very profoundly impressed line above; scutellum piceous; wings dusky, pale brown on the disk, an obsolete, small, subhyaline spot between the middle and the base; a large, subtriangular, hyaline spot near the middle, a small portion of

which is cut off by a nervure; tip with a large, subquadrate oval, hyaline spot, the two arcuated nervures that pass through this spot are margined with blackish; central cellule widely bilobated at the tip, lobes equally approaching the inner margin, a nervure passes from between the lobes to the edge of the wing, an abbreviated nervure passes from the lobe nearest the base, half way to the inner margin, and another nervure connects this lobe with the inner nervure so as to form an additional cellule; feet yellowish; tarsi black; venter pale, two last segments black on the disk; tergum with blackish hair on the incisures."

Say's description does not omit any important characters. *Halcyon* is easily distinguished by having the third posterior cell bisected by a cross vein. The average length is about 13 mm. This species has a very wide range, and I have records of it from Kansas, Nebraska, Colorado, New Mexico, South Dakota (Aldrich), Michigan (Aldrich), Toronto, Ontario (Aldrich), and Southern California. Two specimens in the National Museum (Townsend, 827) from Chihuahua, Mexico, apparently belong here, although they differ somewhat from the typical forms.

Anthrax nigripennis new species (figs. 4 and 5).

This species is near *halcyon*, but the wings are much darker, and areas which are blackish gray in *halcyon*, are deep black in this species. There is a semi hyaline spot in the discal cell, and the usual hyaline spaces in the wing tip are dark, smoky and very narrow. The axillary cell is dark brown, in some specimens blackish. Dorsum of abdomen reddish with a broad black median stripe (see fig. 4), the red in round spots on the sides of each segment. First segment black. Scutellum dark red, the base black. Mesonotum grayish black. In fresh specimens there are indications of gray vittæ on the thorax. Humeral and post alar callosities brownish red. Black pile on distal half of segments 2 to 7, in tufts on the sides. The first two antennæ joints are yellowish red, the third black (fig. 21). Length 12 mm. Wing 13.5 mm.

Type.—U. S. N. M., Cat. No. 20739.

Habitat.—Beltsville, Md. Four specimens were taken July 2 and 4, 1916 (W. R. Walton). Three specimens were collected July 9 in the same locality by the author. Mr. Banks loaned two specimens, one from Falls Church, Va. (June 24), the other from Glencarlyn, Va. (July 2).

Anthrax arethusa O. S. (figs. 11 and 11a).

Anthrax arethusa O. S., Biologia, Dipt., 1, 116.

"A series from Central America and Mexico resemble *halcyon* in having their third posterior cell bisected, but show a marked difference. *A. halcyon* has a more northern distribution. The sides of the abdomen of *halcyon* beset with yellow pile, but on the distal half of the segments, beginning in most specimens with the third, there is a tuft of black pile. The bisecting cross vein is often wanting from both wings, sometimes from one wing only.

"*Arcthusa* differs from *halcyon*: Abdomen red on the sides on all segments; the black forms a broad stripe in the middle, occupying all of the first segment, and is gradually attenuated posteriorly. On the seventh segment the black occupies but a small spot in the middle. The wings are narrower and paler; the interval between the hyaline spot in the discal cell and the posterior margin is almost altogether hyaline, crossed by two veins the second of which is more or less clouded; the cross vein bisecting the third posterior cell is differently placed; in *halcyon* it connects the end of the discal cell with the intercalary vein, and the stump does not come in contact with it; in *arethusa* it connects the intercalary vein with the stump, so that the latter seems to issue from the curve of the cross vein; in some cases the end of the stump disappears, and then the convex cross vein remains.

"In both species the subhyaline spot commonly occurring in species of *Anthrax* near the proximal end of the discal cell is nearly obsolete; in this they differ from *pæcilogaster*.

"In size the average *arethusa* is a little smaller and narrower than *halcyon*. I have six specimens from Guatemala City, five from Irazu, two from N. Sonora, two from Presidio and one from Orizaba. A specimen from Manitou, Colo. (Aug. 17, 1876), seems to belong here, it is larger, the black dorsal stripe of the abdomen is remarkably narrow, and the tufts of black hair on the sides of the abdomen consist of a few hairs only, hardly visible among the yellow hairs."

Anthrax arethusa var. **autumnalis** new variety (fig. 8).

This species answers the description of *arethusa* very well, but does not have the supernumerary cross vein bisecting the third posterior cell. The specimens in my collection are very close to *willistoni* Coq., in general appearance and wing markings. The venter is pale reddish. The specimen figured

has a somewhat narrower black stripe on the abdomen than the average. Length 12-15 mm.

Type.—U. S. N. M., Cat. No. 20741.

Habitat.—Redlands, Cal. Several specimens, all collected in September. The species is very common in this region.

Anthrax effrena Coq. (fig. 7).

“*Anthrax effrena* Coq., Trans. Amer. Ent. Soc., XIV, 182.

Differs from *alpha* only as follows: Proboscis not projecting beyond epistoma. Wings wholly dark brown, except a large hyaline spot near the middle of discal cell encroaching on third posterior cell, a less distinct spot in the middle of the fourth posterior cell and the entire apex of the second submarginal cell; basal half of the third vein and basal two thirds of the sixth vein light yellow. Length 12 mm.”

“Arizona. A single specimen (Williston).”

This species varies from 9-17 mm. in length. All of the material in the National Museum is from Arizona. One small specimen (9 mm. in length) is probably immature. The wing color is pale and indefinite. The abdominal markings seem to vary considerably. The legs are yellowish red. The first two joints of the antennæ are yellowish, the third joint black (fig. 20). Coquillett compared this species with *alpha* but could not have had a correctly determined specimen of *alpha*. The two species do not resemble each other to any extent.

Anthrax alpha O. S.

Anthrax alpha O. S., West. Dipt.

Osten Sacken gives a very good description of this species in his Western Diptera. “Coloring of the wings very like that of *A. halcyon*; second submarginal cell bisected by a cross-vein; in the third posterior, a long stump of a vein. Length 12-14 mm.

“Front, face, and cheeks beset, the former with short black, the two latter with scarce yellow pile; venter black; proboscis not projecting; antennæ black, first joint reddish, with black pile. Thorax grayish black, clothed with pile, which is pale fulvous above and white on the pectus and lower part of the pleuræ. Scutellum reddish, black at base; ground color of the abdomen is grayish black; in rubbed-off specimens only a little red is perceptible on the sides of the second and third segments; in well preserved specimens, the ground color is entirely concealed under a dense, appressed tomentum which is whitish gray on the anterior and brownish fulvous on the posterior half of the segments; an ill-defined blackish spot in the middle of each segment; the

sides of the first two segments are beset with yellowish white pile; the sides of the following segments, beginning with the end of the second, with black, mixed with fulvous pile, the black forming tufts on the hind margins of the segments; the same black pile is scattered over the surface of the abdomen, above the tomentum. Venter: segments 2 to 4 reddish, more or less black at the base; the following segments black, with a reddish posterior margin. Legs red with a golden yellow tomentum and black spines; front femora black at the base; tips of the tibiae and all the tarsi black. Wings tinged with blackish brown; in the apical half, the following spaces are grayish hyaline: a spot in the expanded end of the marginal cell, the end of the first submarginal and nearly the whole second submarginal cell, a streak in the end of the first posterior cell, the three other posterior cells, and the latter half of the discal cell; the veins traversing these subhyaline spaces are clouded with brown. The cross vein bisecting the second submarginal cell is placed in its narrow part, so as to form with the adjacent veins the figure 'A.'

"*Habitat*.—Cheyenne, Wyo., where I found it to be quite common, Aug. 21, 1876. Five specimens.

"Six specimens from near Webber Lake, Sierra Nevada (July 25), agree in all respects with those from Cheyenne; but they are a little smaller, the coloring is a little darker, both on the wings and on the body; the pile on the chest and pleuræ is less white; the tomentum on the abdomen above is the same, but the fulvous prevails over the gray, and the black spots in the middle of each segment are larger, on the second segment, along the hind margin, the black forms a cross band; attenuated on each side, and not reaching the lateral margin; the same is repeated on each following segment, the black spot rapidly diminishing in extent. The venter is reddish without any black at the base of the segments. The portion of the anterior branch of the third vein beyond the supernumerary cross-vein is very distinctly clouded with brown in these specimens while it is not clouded at all or only imperceptibly in the specimens from Cheyenne. I hold this to be merely a local variety of *alpha*."

Coquillett redescribed *alpha* in the Trans. of the Amer. Ent. Soc., XIV, p. 180, and evidently from specimens of another species. The second joint of the antennæ is not red as he says and the wings are not yellowish brown. *Alpha* does not have the "sides of the abdomen sometimes partly or wholly reddish." He makes no mention in his description of the fact that the bases of the fore femora are black.

I have five specimens, from the following localities: Colorado (2 specimens, one from Rocky Ford); Summit, Sierra Nev., Cal.; Wy-

oming and Medicine Hat, Alberta, Canada, Oct., 1911 (J. R. Malloch).

Anthrax signatipennis new species (fig. 10).

Thorax opaque gray black. Abdomen red with a median dorsal black stripe, which varies in width in different specimens and does not reach the end of the seventh segment. The first segment is all black. Scutellum reddish, the base black. Vertex black. The black of the occiput varies in extent. Venter reddish yellow. Tomentum of mesonotum golden yellow. In most of the specimens the yellow tomentum of the abdomen is sparse. Front and epistoma with short black pile varying somewhat in extent, the rest of the pile on the head is pale yellow. The tufts of black pile on the sides of the abdominal segments are quite noticeable. Wings brown, marked with hyaline spots (see fig. 10). The hyaline spot in the middle of the wing is quite often narrow and does not reach the wing margin. The anal and axillary cells are both dark brown. Legs yellowish with black bristles, the tarsi darker, especially the front pair. First two joints of antennæ yellowish red, the last joint black (fig. 19). Length 10.5 to 13 mm.

Type.—U. S. N. M., Cat. No. 20740. Seven specimens. All in U. S. N. M.

Habitat.—Type from Yellowstone Park, Aug 12, 1907 (W. Robinson). One specimen from Miles City, Montana, Aug. 24, 1915. Three specimens from Reno, Nevada, Sept. 2, 1915 (H. G. Dyar).

The Nevada specimens differ slightly, one having more gray color to the wings, the hyaline spots being smoky. In the other two specimens the dorsum of the thorax, abdomen and scutellum is thickly covered with yellow tomentum. Mr. Nathan Banks compared these specimens with material in Museum of Comparative Zoology and found them to be identical with specimens labelled "new species" by Osten Sacken, from Shasta Co., Cal.

Anthrax willistoni Coq.

Anthrax willistoni Coq., Trans. Amer. Ent. Soc., XIV, 181.

Coquillett mentioned as a synonym of this species, *Anthrax* sp. nov., near *fuliginosa* Lw. Williston, Can. Ent., Vol. XI, p. 216.

"Differs from *alpha* in that the middle part of the veins between the first and second submarginal cells and between the discal and third posterior cell, and sometimes that between the third and fourth posterior cells are not bordered with brown, and the axillary cell, except its base and apex is wholly hyaline." Length 11 to 14 mm. Cal., N. M., Colo. 4 specimens.

This species is near *pæcilogaster* O. S. and *arethusa* O. S. A specimen labelled "Near Lander, Wyo., 5,000–8,000 ft. Aug. (Roy

Moodie)," has the brown of the wings very pale. This may be an immature specimen. All the abdominal segments except the first have short white tomentum mixed with the usual yellow tomentum. In most specimens the tarsi are dark. This species does not have the base of the front femora dark as in *alpha*. Some specimens have the lateral margins of all segments except the first reddish.

Anthrax pæcilogaster O. S. (fig. 12).

Anthrax pæcilogaster O. S., *Biologia*, Dipt., 1, 118.

"Head yellowish, almost wax-color, with appressed golden pubescence, and black, erect hairs; vertex black, the upper part of the occiput grayish, beset with pale orichalceous appressed hairs; basal joints of antennæ reddish, third joint black. Thorax grayish-brown, with an appressed fulvous pubescence forming a pair of indistinct stripes in the middle, and longer, erect fulvous hairs in front and on the sides (when the pubescence of the dorsum is not abraded and the surface not greasy, two dark stripes are visible on the grayish-brown background). The scutellum reddish, black at the base. First segment of abdomen black, the others rufous, with a transverse black spot in the middle of each, beginning with the second (these spots visible in abraded specimens only). The hairy covering of the abdomen consists of a partly rufous, partly yellowish white tomentum, the latter predominating on the sides and on the anterior part of the second segment. In well-preserved specimens, in the middle of each of the segments 2, 3, and 4, there is a short, tuftlike crossband of black hairs, broadly interrupted in the middle, the interruption being filled with a whitish tomentum; tufts of black hairs along the abdomen, beginning with the second segment; legs rufous, the tips of the tarsi darker. Knob of the halteres whitish. Wings on the pattern of *halcyon*, but narrower; a stump of a vein within the third posterior cell; a hyaline spot close by the axillary incision across the middle of the axillary cell, sometimes reaching the anal cell also; the ends of the second and upper branch of the third vein thickly clouded with brown; the hyaline space in the discal cell rather large and in contact with the fourth vein; the hyaline space connecting this spot with the posterior margin rather clear, the intercalary spot at the distal end of the second basal cell very distinct; the brown color not very dark and variegated with yellowish rufous. Length 11 to 12 mm.

"*Habitat*.—North America, Cal., Mexico, N. Sonora, Tehuacan. Seven specimens.

"*Pæcilogaster* differs from *arctusa* as follows: (1) Third posterior cell is not bisected, but contains a stump of a vein; (2) the black tufts on the sides of the abdomen are very distinct on the second, as well as on the following segments; (3) the hyaline spot in the distal half of the second basal cell near the proximal end of the discal cell is not obsolete, but very distinct; (4) there is a more

or less distinct hyaline spot across the axillary cell, close to the axillary incision, and reaching sometimes into the second basal; (5) the well preserved specimens show, on segments 2, 3, and 4 of the abdomen, short, tuftlike interrupted crossbands of dark hairs, easily abraded. I notice that in all my specimens the ends of second vein and anterior branch of third are distinctly diverging, while they are more or less parallel in *arethusa*.

"I have 5 specimens from Shasta, Cal. (Edwards), which somewhat resemble *pacilogaster*, but are, on the average, a little larger and broader, the axillary cell, the hyaline spots in the third and fourth posterior cells smaller; the tomentum on the abdomen is principally yellow and not mixed white. The third posterior cell is not bisected, but has a stump of a vein (as in *pacilogaster*). Is this again, a different species?"

Mr. Banks noted this unnamed species in the collection at the Museum of Comparative Zoology and says that it is the same as *willistoni*, Coq., near which it is placed.

Anthrax pilosa new species.

Body color dull grayish black. The abdomen is almost entirely obscured by dull yellow pile, beneath which is a yellow tomentum. The incisions have a few black hairs, and there are a few at the sides of each segment. The hind borders of segments 2 to 6 are banded with a yellow brown tomentum. There is a band of black tomentum on the second segment which does not reach the lateral margins, a still smaller band on the third segment. Spines of the thorax and scutellum yellow, the pile and tomentum yellow. Vertex black. Frons and epistoma with very sparse black pile and yellow tomentum. Basal joints of the antennæ reddish, the third joint black and slightly longer than the first two (fig. 15). Legs yellowish red, the tarsi darker. Coloring of wings very pale yellowish brown and not sharply defined. The smoky hyaline spaces blend in with the wing pattern. Occiput black with yellowish white tomentum. Venter blackish, the hind margins of the first two segments marked with red. The type has a small red spot on each side of the second segment. Scutellum red, the base and sides black.

Type.—U. S. N. M., Cat. No. 20738. Four specimens.

Habitat.—Los Angeles Co., Cal.

This species is nearer *fuliginosa* than any other. The four specimens in the National Museum were collected by Coquillett and labelled *A. alpha* with a query.

Anthrax flaviceps Loew.

Anthrax flaviceps Loew., Cent. VIII, 132.

I give below a rather free translation of Loew's description in his Centuries: "Black, opaque. Head yellow, vertex and occiput black, frons and face with black pile and yellow tomentum, the oral margin in front furnished with short black pile; the proboscis not prominent; first antennal joint yellow or brownish, closely black pilose; second joint black, with short black pile; third joint not present in this specimen. Thorax with fulvous pile. Scutellum except base red. Abdomen wholly black, lateral margins with fulvous pile, the pile however is black on the posterior angles of the segments. Dorsum of abdomen wholly yellow tomentose the sides are furnished with yellow pile and the hind margins of the segments with black pile. Venter black, the posterior margins pale and the sparse pile yellow. Legs testaceous, the base of front femora, the tibiae except base, the rest of the tibiae to the apex of the tarsi all black. Wings fuscous cinereous, venation similar to *A. halcyon* Say, appendiculate vein from discal cell in third posterior is missing; this cell being in one, not divided in two parts as in *A. halcyon* Say. Adventitious veins sometimes occur; sometimes arising from the intercalary vein.

"From Tamaulipas, Mex. Type in Museum of Comparative Zoology." Mr. Banks notes in comparing specimens that *pilosa* is very near *flaviceps*, but the latter is even more obscurely marked."

Anthrax demorgon Walker.

Anthrax demorgon Walker, List, 2, 265.

"Body black; head clothed with black hairs; ferruginous between the eyes, tawny in front; mouth tawny; feelers and sucker black; eyes dark red; chest and breast, and especially the latter clothed with red hairs; scutcheon ferruginous, excepting the fore border; abdomen dull black, piceous beneath, clothed with red hairs, and having a fringe of black hairs on each side; legs dark ferruginous, beset with black bristles, feet piceous; wings blackish brown, having near the fore border in the middle of the length a large ferruginous spot, which also stretches along the borders of the veins; beneath this there are three colorless spots, which occupy as many areolets, the first nearest to the hind border is small, the second is larger, the third is triangular and larger; beyond the latter and nearer to the hind border there are two very small, and sometimes almost obsolete colorless spots; the tips of the wings are pale gray, excepting two stripes which follow the curves of the veins and are joined together at each end; wingribs and veins piceous; poisers tawny, their knobs piceous above. Length of body 6 lines; of wings 16 lines.

"Florida.

"The fork on the base of the fourth areolet on the hind border, reckoning from the base of the wing, is longer than that of *A. halcyon*."

This is probably the same as *A. ceyx* Lw. *A. ceyx* occurs in Florida and there appears to be no other species which corresponds to the description.

Anthrax ceyx Lw. (Syn.? *demorgon* Walker).

Anthrax ceyx Lw., Cent., VIII, 30.

Coquillett redescribed *A. ceyx* in Trans. Amer. Ent. Soc., XIV, p. 181. I give his description below:

"Front brownish, the crown black tomentose and pilose; face reddish, much produced below, black tomentose and pilose; proboscis projects length of labella or less beyond epistoma; first joint of antennæ reddish, about three times as long as second, second and third joints black, third joint elongate, conical at base (fig. 17); occiput black, reddish tomentose. Thorax black, reddish tomentose, front end reddish and black pilose, bristles of hind angles reddish and black; pleura reddish and black pilose; scutellum reddish, the base black, reddish tomentose, the bristles reddish and black. Abdomen black, the sides sometimes partly reddish, mixed black and reddish tomentose; pile of sides black, that on sides of first and second segments largely reddish, on the others mixed with a few reddish ones, venter reddish, mixed reddish and black pilose. Legs reddish, sometimes partly black, reddish tomentose, front tibiæ destitute of bristles; tarsi black, claws of front tarsi minute. Wings brownish black, the following parts hyaline; a spot in the apex of marginal cell, a larger spot in apex of first submarginal cell nearly as long as the second submarginal cell, a spot in the center of the second submarginal cell extending nearly the whole length of that cell a streak in apex of first posterior cell, or in the middle of second posterior cell, a spot in the base and another in the apex of the third posterior cell, a spot near the center of the fourth posterior cell and a large spot in apex of discal cell; veins between these hyaline parts bordered with brown; a lighter streak in the middle of anal and another in middle of axillary cell; costal cell brownish; apical half of first basal cell reddish yellow; vein between discal and third posterior cell much bowed downward and emitting a stump of a vein which projects into the third posterior cell. Length 15 mm.

N. Carolina, Va., Ga., Fla. Single specimen (Keen)."

Loew's description is from the ♂. Similar to *halcyon* Say, but color of body and vestiture darker and more obscure. Legs darker, anterior tarsi narrower and longer. (Va.) The femora and tibiæ have black tomentum beneath.

Anthrax fuliginosa Lw.

Anthrax fuliginosa Lw., Cent., VIII, 31.

I have three specimens from Texas which I believe to be the true *fuliginosa*.

Head pale yellow, venter and occiput black. Dorsum of abdomen and thorax grayish black. A red spot on the sides of the second and third abdominal segments. Frons wide, reddish in front of vertex. Frons and oral margin with black pile. Cheeks and face with short yellow pile. Scutellum dull red, the base black. Straw yellow tomentum and pile on thorax and abdomen. Bristles yellow. Legs reddish yellow, the base of front femora, tarsi, tips and innersides of tibiæ black. Bristles of legs black. Venter and body black. Black pile on margins of all except first segment, tufts of black pile on the posterior corners. Black tomentum on base of scutellum. Proboscis barely reaching oral margin. First joint of antennæ reddish, the second and third black (fig. 13). Wings brown, but the color is not sharply defined. No clouds on ends of the branches of the third vein or on the end of the second vein. Most of the axillary cell smoky hyaline, and discal cell with large hyaline spot. A light streak in base of marginal cell, the end of first basal and most of second basal cell yellowish. The end of first posterior and most of the second, third and fourth posterior cells smoky hyaline (fig. 22). Length 15 mm. Wing 17 mm.

Type.—Loew's type was from California.

There are two specimens in the National Museum from Cotulla, Texas, May 12, 1906 (F. C. Pratt.), and one specimen from Texas, with no data. These specimens are remarkable for the spurious veins and stumps of veins in the wings.

The status of this species has been in question for some time. Osten Sacken was not sure of certain of his species which he placed under *fuliginosa*. Coquillett made *fuliginosa* a variety of *alpha* O. S. or a variety of what he considered was *alpha*. Osten Sacken referred to *fuliginosa* a specimen from N. Sonora and one from Texas (Coll. von Roder). Coquillett stated that "*fuliginosa* differs from the typical *alpha* in that the outline of the brown color of the wings is not well defined, the parts of the wing that in *alpha* are pure hyaline are here blackish gray and the veins between the submarginal and posterior cells are not distinctly bordered with brown." In a note he adds "this is but an immature form of *alpha*."

Coquillett had six specimens from California and Texas. From his description and the size of the species (10–13 mm. in length) it is very probable that the specimens from California are those which I describe as *A. pilosa* n. sp. Mr. Nathan Banks compared my Texas specimens with Loew's type (which is rubbed) and finds my determination to be correct.

EXPLANATION OF PLATES.

PLATE 3.

Fig. 1. *Anthrax californicus* n. sp.Fig. 2. *Anthrax haleyon* Say.

PLATE 4.

Fig. 3. Abdomen of *A. californicus* from above.Fig. 4. Abdomen of *A. nigripennis* n. sp.Fig. 5. Wing of *A. nigripennis*.Fig. 6. Wing of *A. haleyon* (local variety).

PLATE 5.

Fig. 7. *Anthrax effrena* Coq.Fig. 8. *Anthrax arethusa* var. *autumnalis* n. var.

PLATE 6.

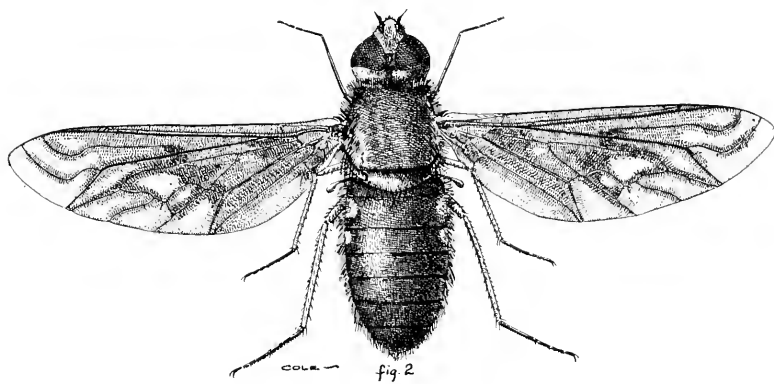
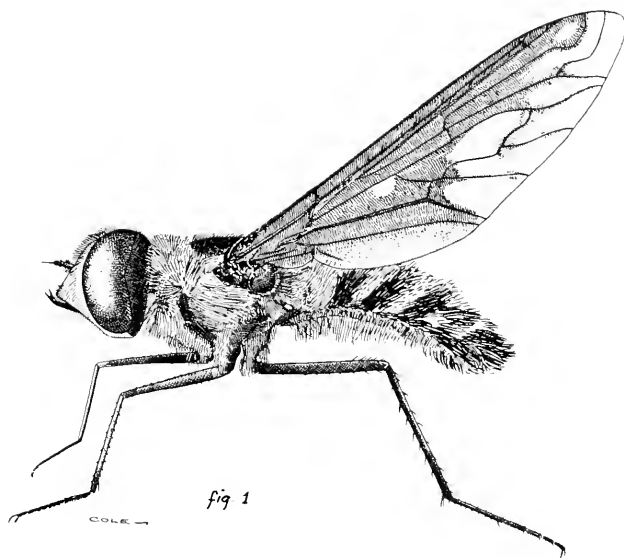
Fig. 9. *Anthrax alpha* O. S.Fig. 10. *Anthrax yellowstonei* n. sp.

PLATE 7.

Fig. 11. *Anthrax arethusa* O. S., Abdomen. (Redrawn from Osten Sacken.)Fig. 11a. *Anthrax arethusa* Wing. (Redrawn from Osten Sacken.)Fig. 12. *Anthrax pacilogaster* O. S., Abdomen. (Redrawn from Osten Sacken.)Fig. 12a. *Anthrax pacilogaster*, Wing. (Redrawn from Osten Sacken.)Fig. 13. Antennæ of *A. fuliginosa* Loew.Fig. 14. Antennæ of *A. californicus* n. sp.Fig. 15. Antennæ of *A. pilosa* n. sp.Fig. 16. Antennæ of *A. alpha* O. S.Fig. 17. Antennæ of *A. ceyx* Lw.Fig. 18. Antennæ of *A. arethusa* var. *autumnalis* n. var.Fig. 19. Antennæ of *A. yellowstonei* n. sp.Fig. 20. Antennæ of *A. effrena* Coq.Fig. 21. Antennæ of *A. nigripennis* n. sp.Fig. 22. Wing of *A. fuliginosa* Lw.

MISCELLANEOUS NOTES.

Cardiola obscura Grav. on Staten Island.—I found this aleocharid beetle in some numbers under a pile of decayed weeds in my garden on December 5. Mr. A. S. Nicolay very kindly mounted the specimens for me and sent some to Dr. A. Fényes, by whom the identifi-



Anthrax.

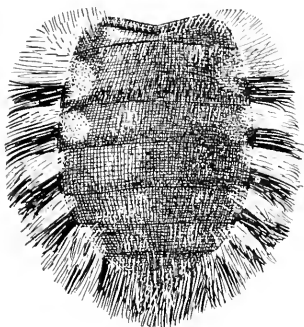


fig 3

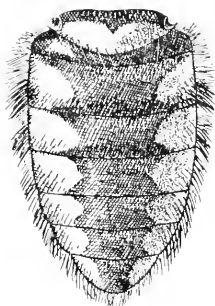


fig 4

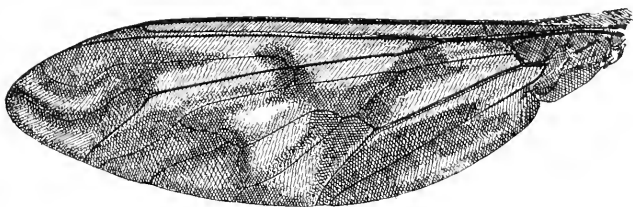


fig. 5

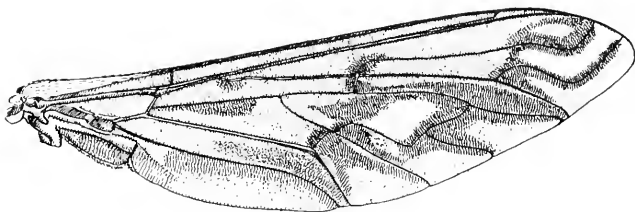
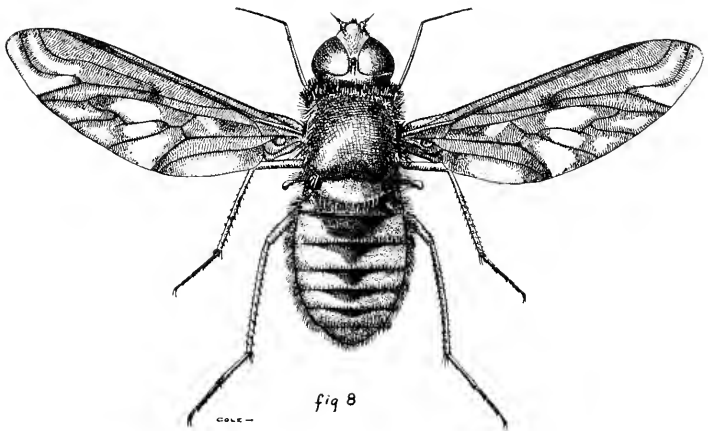
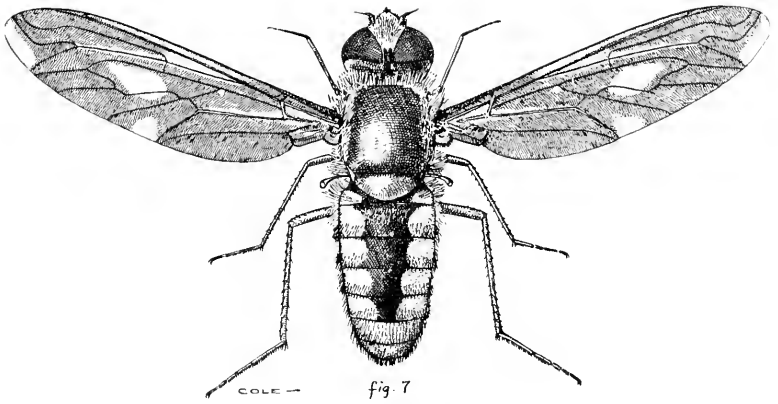
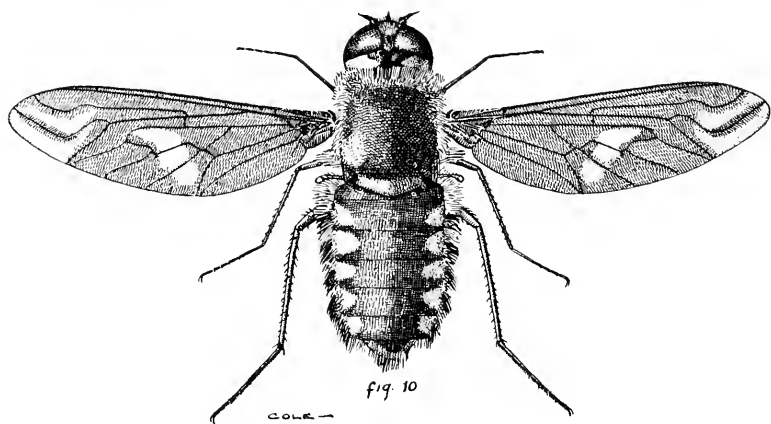
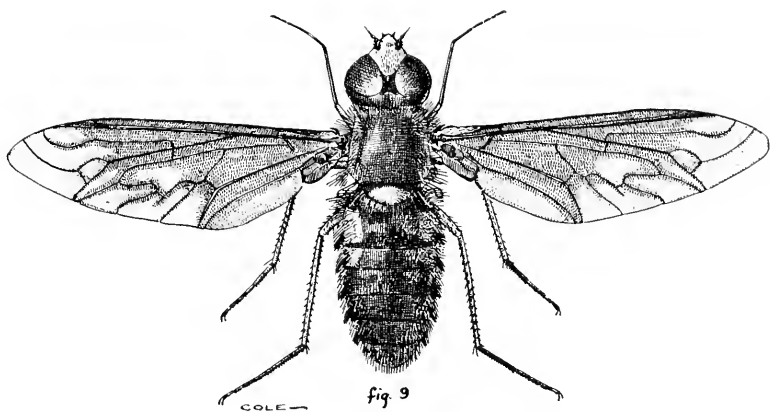


fig. 6

Anthrax.



Anthrax.



Anthrax.



fig 11

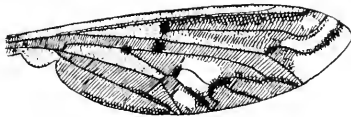


fig. 11a



fig 12

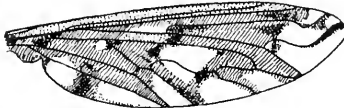
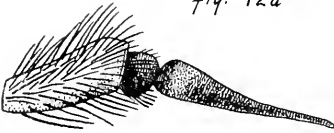


fig. 12a



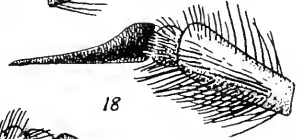
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17



14



18



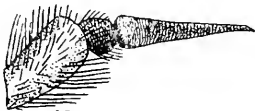
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19



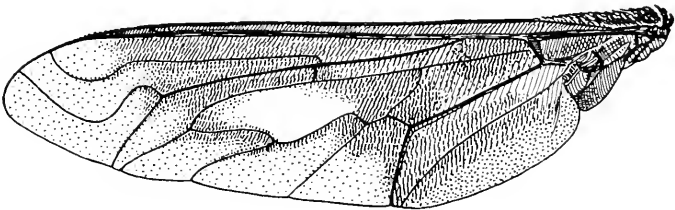
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16



21



22

Anthrax.



cation was made. In his letter to Mr. Nicolay, Dr. Fényes states that he has the species from various parts of the United States, being apparently an importation from the Palearctic region. Col. Casey seems to take nearly the same view in Trans. Ac. Sci. St. Louis, XVI, p. 231, but, as he mentioned only a single specimen from Mt. Airy, Pa., saying that it was by no means certain that it had established itself, it may be well to publish this additional record.—C. W. LENG.

An Appreciation of the Weevil Book.—A copy of Blatchley and Leng's weevil book came duly to hand, and I have tested it pretty thoroughly in verifying and working over a large material in the families treated that occur east of the Mississippi river. The tables and descriptions are concise and practicable, and work out nicely. One of the best tests of such a work is the ease and accuracy with which one can use it in the identification of species. In this respect the authors have succeeded well. The illustrations are good and very useful. The presswork is clean and perfect. Messrs. Blatchley and Leng are entitled to the thanks of all entomologists for this excellent book which will undoubtedly prove very useful to students, and is a work they can not afford to be without.—CHARLES DURY.

BOOK NOTICE.

Rhynchophora or weevils of North Eastern America. By W. S. BLATCHLEY AND C. W. LENG. Indianapolis, the Nature Publishing Co., 1916. 682 p. illus. 22.5 cm.

Probably at once the most useful and most used volume for the student of our North American beetles during the past several years, has been Mr. Blatchley's *Coleoptera of Indiana*. It is the sort of a handbook that is exactly what one wants, and that cannot be used without a sense of thankfulness for its merits and even for its mere existence,—I might almost add without becoming a beetle enthusiast. The weevils, which have been rather dreaded by the tyro as a peculiarly difficult group, were not included. It may be imagined then with what pleasure we learned that Mr. Blatchley and Mr. Leng had jointly under way the preparation of a companion volume for the weevils not merely of Indiana, but of the entire eastern half of North America. Now that it has appeared, our anticipation culminates in the keenest satisfaction. It is in style and treatment

similar to the Coleoptera of Indiana, but the inclusion of all of our eastern species (despite the more modest pretense of its title) and the rather full statements of distribution enormously increase its usefulness, and elevate it at once to the front rank of American entomological text-books.

The aim of the work has been, in the words of the author "To furnish students and tyros in entomology a simple manual which would enable them in the most direct way possible to arrange, classify, and determine the scientific names of the weevils in their collections." Therefore undue technicality has been avoided. Two factors that contribute much toward the attainment of the aims of the work, as thus set forth, are the keys and the illustrations. The latter are numerous, uniformly excellent, and in a considerable measure original. The former are lucid and give evidence of much care and discrimination and of the same appreciation of the viewpoint of the novice that characterizes the keys in the "Coleoptera of Indiana," and makes them easily useable. The senior author is responsible for the keys and descriptions, except in the Scolytidæ and the genus *Balaninus*, which were prepared entirely by Mr. Leng.

The introduction contains an interesting summary of the structure and structural variations within the Rhynchophora. Particularly interesting is the discussion of the antennæ. These organs show a progressive modification which has been used as the chief basis for the interpretation of the phylogenetic relations of the major groups and assignment to their respective positions. The most primitive form is found in the Brentidæ, in which they are straight, without a club, and the segments subequal. In the Rhinomacerinæ and Anthribidæ the last three segments are widened and form a weak club, but retain their relative lengths. In the Apioninæ, Allocoryninæ and Tachygoninæ (Curculionidæ), the last three segments are modified into a club, but are distinctly separated by sutures, the three being of equal length, or the last one elongate. In the great bulk of more highly specialized Rhynchophora we find a development in a different direction. "The first joint becomes more or less elongate, . . . and beyond it the antenna is suddenly bent, elbowed or 'geniculate' . . . concurrently we find the development of grooves to receive the antennæ. . . . The club is usually compact, formed of three approximately equal joints separated by sutures; the whole

antenna is usually pubescent and highly sensitive; the funicle . . . is composed of seven, rarely fewer joints. The next and final step in antennal development is manifested in various directions, either as unusual forms or scape, or by reduction in the number of funicular joints, by loss of pubescence on parts of the antenna, or by enlargements or unusual forms of the club. Important among these final developments is the enlargement of the first joint of the club instead of being approximately equal to the other two. . . ." By this last character the authors would prefer to recognize the Calandridæ of Leconte and Horn as a distinct family, but out of deference to the opinion of others, refrain from doing so. Finally, in the Scolytidæ "developments begun in Calandrinæ are continued and variations multiplied. In one group the scape becomes sexually clothed with long hair, in another the funicle is reduced to a single joint; the sutures of the club are often obsolete, and its surface becomes in part corneous, while the form of the club often varies, at times assuming grotesque proportions."

For more than a generation the beginner has been deterred from the study of Rhynchophora by the difficulty attached to the family keys published by Leconte and Horn. Not only must both sexes be at hand in order to use those keys, but the under surface of the elytra must be examined for an "inner fold," and as to whether this fold, if present, is "feeble" or "strong" in the opinion of the authors. Hayward's Classification of the families of Coleoptera, published in 1909 (but prepared prior to his death in 1906) merely repeats Leconte and Horn's key, with the addition of the Brenthidæ which was accidentally omitted by those authors. Probably in no single respect is the present volume more satisfactory than in substituting for this old key to the families, an entirely new one which can be readily applied by anybody.

W. D. Pierce, who has been the most prolific writer on North American Rhynchophora in recent years, stated in 1909 that the most recent writers on the Rhynchophora seem to agree in the main in considering only four families—Curculionidæ, Anthribidæ, Brenthidæ and Ipidæ (Scolytidæ). Pierce "for the time being" adopted that arrangement, and it has been followed, with commendable judgment by Blatchley and Leng. More recently Pierce has drifted toward a much more radical classification, and in this has been

supported, so far as the Scolytidæ are concerned, by A. D. Hopkins. It is worth while to compare the classification elaborated by Pierce in a very recent paper,¹ with that adopted by Blatchley and Leng (which is the old system of Lacordaire) and also with that of Leconte and Horn. In doing this I do not mean to intimate that the former would have been more satisfactory for the text under consideration. Indeed, although in my ignorance of the group not fairly entitled to an opinion, my personal predilections are strongly for the more conservative classification.

If Pierce (1916) is correct the maxillary palpi of Brentidæ are flexible, a fact evidently unknown to Blatchley and Leng, as also to Leconte and Horn. If true this character will support the primitive position to which they have assigned that family. They have shown that the so-called flexible palpi of Anthribidæ and Rhinomacerinæ, while less rigid than in other Rhynchophora, still preserve the general character of the palpi observed throughout the suborder.

In a text book of this kind, it is particularly important to be conservative (as the authors have been) in discarding established names, but it would also seem desirable to introduce parenthetically or as alternative names those which will probably come to be used in the future, or are by some authors used at present as the correct group names. Such a course would not increase the beginners' difficulties, but would simplify them, for they would greatly help him in correlating the special literature of the subject with his manual. A study of the type genera of the groups would doubtless have enabled the authors to foreshadow the several changes that Pierce has since shown to be necessary, such as the correction of the universal misspelling of Brentidæ, Doydirhynchinæ for Rhinomacerinæ, etc. These are however very minor points, and were the reviewer desirous of mentioning only defects, this review would have to be exceedingly brief for lack of material to write about.—J. Chester Bradley.

¹ Studies of weevils (Rhynchophora) with descriptions of new genera and species. By W. Dwight Pierce. Proceedings of the United States National Museum. 1916. 51: 461-473.

Pierce (1916) and Hopkins (1915) ¹	Blatchley and Leng (1916)	LeConte & Horn, 1882 ²
Series Phytophaga	Suborder RHYNCHOPHORA	Suborder RHYNCHOPHORA
Subseries 2. Rhynchophora		
Superfamily 4. <i>AGLYCYDEROIDEA</i> ²		
Family <i>Aglycyderide</i>		
Family <i>Protorhinide</i>		
Superfamily 5. BRENTOIDEA	Family BRENTHIDE	Family 80. BRENTHIDE
Family BRENTIDE		Subfamily <i>Brenthide</i>
[= BRENTHIDE]		Subfamily <i>Cyladine</i>
Superfamily 7. PLATYSTOMOIDEA	Family ANTHRIBIDE	Family 83. ANTHRIBIDE
Family <i>Bruchelide</i>		
Family PLATYSTOMIDE		
[= ANTHRIBIDE]		
Family CHORAGIDE		
	Family CURCULIONIDE	
Superfamily 8. DOYDIRHYNCHOIDEA	Subfamily <i>Rhinomacrine</i>	Family 74. RHINOMACERIDE
Family DOYDIRHYNCHIDE		
[= RHINOMACERIDE]		Family 70. ATELLABIDE
Superfamily 9. ATELABOIDEA		Family 75. RHYNCHITIDE
Family b. ATELLABIDE	{ Subfamily <i>Rhynchitina</i>	Subfamily <i>Rhynchitina</i>
	{ Subfamily <i>Attelabina</i>	
Family d. PTEROCOLIDE	Subfamily <i>Pterocolina</i>	Subfamily <i>Pterocolina</i>
		Family 79. CURCULIONIDE
Family a. APIONIDE	Subfamily <i>Apionina</i>	Subfamily 4. <i>Apionina</i>
	Subfamily <i>Allochorhynina</i>	
	Subfamily <i>Ithycerina</i>	Subfamily 3. <i>Ithycerina</i>
Family c. TACHYGONIDE	Subfamily <i>Tachygonina</i>	
Family e. <i>Oxyrhynchide</i>		{ Subfamily 1. <i>Sitonina</i>
Superfamily 10. BRACHYCEROIDEA		{ Subfamily 2. <i>Alphina</i>
Family <i>Brachyceride</i>		{ Subfamily 5. <i>Curculionina</i>
Family <i>Microceride</i>		{ Subfamily 6. <i>Balanina</i>
Superfamily 6. CURCULIONIDE		
Family a. PSALLIDIDE	Subfamily <i>Otiiorhynchina</i>	Family 78. OTIORHYNCHIDA
[= BRACHYRHINIDE]		
[= OTIORHYNCHIDE]		
Family b. <i>Psalliduride</i>		
Family c. <i>Plinthide</i>		
Family d. HYPERIDE		
Family e. CURCULIONIDE	} Subfamily <i>Curculionina</i>	
Family f. <i>Orobitide</i>		
Family g. CRYPTORHYNCHIDE		
	Subfamily <i>Theecesternina</i>	Family 77. BYRSOIDEA ³
		Family 81. CALANDRIDE
Family i. COSSONIDE	Subfamily <i>Cossonina</i>	Subfamily <i>Cossonina</i>
Family h. RHYNCHOPHORIDE	Subfamily <i>Calandrina</i>	Subfamily <i>Calandrina</i>
[= CALANDRIDE]		Subfamily <i>Rhinina</i>
Subseries Phytophaga		
Superfamily 1. SCOLYTOIDEA	Family SCOLYTIDE	Family 82. SCOLYTIDE
Family d. PLATYPODIDE	Subfamily <i>Platypodina</i>	Subfamily <i>Platypodina</i>
Family c. <i>Scolytoplatypodide</i>		
Family b. SCOLYTIDE	Subfamily <i>Scolytina</i>	{ Subfamily <i>Scolytina</i>
Family a. IPIDE	Subfamily <i>Ipina</i>	
Superfamily 2. MYLABROIDEA		
Family MYLABRIDE [= BRUCHIDE]		
Superfamily 3. CERAMBYCOIDEA	} Suborder COLEOPTERA (gennina)	} Suborder COLEOPTERA (gennina)
Superfamily CHRYSOMELOIDEA		
	(in part)	(in part)

¹ The order of arrangement of the groups in the first and third columns of this table is modified to correspond as closely as possible with that of Blatchley and Leng, but the original order is indicated by the numbering or lettering of the groups, wherever they have been changed.

² Groups not occurring in eastern North America are italicized.

³ The family Byrsopidae of LeConte and Horn has been wholly dissolved by Blatchley and Leng.

PROCEEDINGS OF THE NEW YORK ENTOMOLOGICAL SOCIETY.

MEETING OF NOVEMBER 7.

A regular meeting of the New York Entomological Society was held November 7, 1916, at 8:15 P. M., in the American Museum of Natural History, President Harry G. Barber in the chair with 14 members and six visitors present.

The Curator reported the rearrangement of the Local Collection of Bruchidæ and Cucujidæ at the Saturday afternoon meetings and announced the subject for November 19—Colydiidæ.

Mr. William Dunn, of 15 Broad St., was nominated for active membership by Mr. Dow.

Prof. W. S. Wright of San Diego, Cal. (local address 403 W. 115th St.), was nominated for active membership by Mr. Davis.

Mr. Dow read a paper on the "Proper Pronunciation of Scientific Names," in which he pointed out, after giving credit to A. L. Melander, of the State College of Washington, that such names, being supposedly Latin words, should follow the recognized American sound and accents were which explained in detail and numerous illustrations were given, of which a few, quite different to the usual pronunciation employed, as *Cuterebra*, *Aeschna*, *Plecomia*, *Xyleborus*, *Pentatoma*, *Galerita*, *Forficula*, *Amara*, *Hippodamia*, *Nemognatha*, *Pachybrachys*, made a deep impression.

The paper was discussed by Mr. Dickerson, who said the importance of a correct and uniform pronunciation was recognized in the latest text books; by Dr. Forbes, who pointed out some differences of opinion, among experts on the subject; by Mr. Davis, who praised Francis Walker for coining words we can all pronounce; and by Messrs. Sherman and Barber. Mr. Dow closed the discussion by a reference to Spinola coining 38 scientific names by making anagrams of his sweetheart's name.

Dr. Forbes spoke on the "Auditory Organs of the Lepidoptera," illustrating his remarks by blackboard diagrams, drawings and specimens shown under the microscope. His remarks will be published in "Psyche."

Mr. Woodruff exhibited the insects caught at Lakehurst, October 12, 1916, while there with Mr. Davis, consisting of many moths taken at sugar, among which *Xylina patelfacta*, an addition to the New Jersey List, was especially noteworthy, Coleoptera largely from beneath pine bark including a series of *Rhagium lineatum* found lately matured in its nests, and Orthoptera of which a long winged *Conocephalus brevipenne* was conspicuous.

Mr. Davis, commenting on the same excursion, said the nights were so cold that overcoats were a comfort, and that the moths though numerous were numb; it recalled published accounts of sugaring in winter.

There was a surprising scarcity of Orthoptera also in comparison with a previous trip at the same date, but specimens of *Occanthus exclamationis* were the first of the species found at Lakehurst.

Mr. Davis also showed by original notes sent to the late John B. Smith, that he had not reported *Elater nigrinus* but *Elater nigricans*, the error being due to similarity of name and one for which he was not responsible.

Mr. Davis also exhibited *Vanessa milberti*, found November 3, 1916, at Dongan Hills, Staten Island, confirming a previous record by Gustav Beyer.

Dr. Forbes suggested a series of Saturday afternoon meetings devoted to Lepidoptera to alternate with the Coleoptera meetings. Messrs. Woodruff, Davis, Shoemaker and Mutchler approved the suggestion, and the first meeting was arranged for November 12.

MEETING OF NOVEMBER 21.

A regular meeting of the New York Entomological Society was held November 21, 1916, at 8:15 P. M., in the American Museum of Natural History; President Harry G. Barber in the chair with 21 members and eight visitors, including Dr. Bequaert, Prof. Wright, Dr. and Mrs. M. Blyn, Messrs. Burns, Richardson, Mabie and Dr. M. Garcia-Banus of Madrid, present.

The Curator reported completion of Local Collection of Colydiidæ at the Saturday afternoon meeting of coleopterists and announced the subject for December 2 as Monotomidæ, Rhyssodidæ and Lyctidæ.

Mr. Davis reported the study of *Notodonta* at the Saturday meeting of Lepidopterists, expressing his appreciation of the assistance of Dr. W. F. M. Forbes and announced the subject for Nov. 25 as *Acronycta*.

On motion, the Secretary, as instructed, cast an affirmative ballot for the election of Mr. William Dunn of New York and Prof. W. S. Wright, of San Diego, Cal., as active members of the Society.

Mr. Leng announced that Mr. Howard Notman, 136 Joralemon St., Brooklyn, had undertaken, with the consent of Dr. Bradley, the preparation of the Mss. of the N. Y. State List of Insects, Coleoptera, and that records therefor should in future be sent to him.

Mr. Bird read a paper on "A New *Papaipema* Species Occurring in our Fifty-mile Zone" and exhibited specimens of the adult moth and its larva. This paper will be published in full.

Dr. Bequaert read a paper "On American Wasps" illustrated by specimens and blackboard enumeration of the species of Wasps. The latter will be found in Miscellaneous Notes.

The paper was discussed by Mr. Dow, who recalled nests observed at Williamstown, Mass., and Lahaway, N. J., by Dr. Lutz, who mentioned the extraordinary nests of *V. crabro* beneath the verandah of Mr. E. D. Harris's home at Yonkers, N. Y., and other nests found by Dr. Love; by Mr. Davis, who pointed out that the darker-colored nests made by *V. maculata* resulted from its preference for dead wood, like old fence posts, while the paler color of *crabro* nests was the result of its using new wood, as for instance those he had watched in Mr. Bird's garden, gnawing of lilac bark; by Dr. Forbes, who referred to the nests, possibly of *diabolica*, commonly found in New England stone walls; by Mr. Schaeffer, Mr. Olsen and others.

In reply to a question, Dr. Bequaert said the wasps of temperate climes were less unkind to man than those he had studied in the tropics, so that he had found it possible to pursue his investigations without being stung very much, and that *maculata* was less liable to sting than other species.

Dr. Bequaert also exhibited *Volucella fasciata*, bred from *Opuntia* leaves, and *Methoca stygia* Say ♀ (♂ = *bicolor* Say).

Mr. Bird exhibited a wasp attached to a bare golden rod stem, as he had observed it sleeping, and labelled "*Ammophila pictipennis* in the arms of Morpheus."

Mr. Barber read a paper on "Interesting Hemiptera taken in Virginia in 1916," illustrated by specimens, in which he referred to his visits to Vienna, Va., Great Falls, Va., Chesapeake Beach, Md., Glen Falls and Washington, D. C., in part with Mr. Otto Heidemann, and to the wealth of rare species found there, due to its more southern latitude, the extent of wild forest land, the migration of species eastward via Potomac river and northward via Piedmont plateau and Atlantic coastal plain.

Mr. Mutchler exhibited a specimen of the longhorn beetle *Chlorophorus annularis* Fab., known from India, Java, Sumatra, and Borneo, found by W. S. Blatchley at Dunedin, Fla. He also exhibited for Mr. Weiss, *Acyptothus orchivora* Blackb., a weevil found under glass in New Jersey attacking stalks of *Dendrobium* sp. and *Vincetoxicum japonicum* as an insect catching plant with mosquitoes, flies and moths caught in its flowers.

MEETING OF DECEMBER 5.

A regular meeting of the New York Entomological Society was held December 5, 1916, at 8:15 P. M., in the American Museum of Natural History, President Harry G. Barber in the chair, with 23 members and eight visitors, including Dr. M. Garcia-Banus, of the Rockefeller Institute, present.

The Curator reported further work on the Local Collection and announced the subject for the next Saturday afternoon meeting, the family Buprestidæ.

The following members were elected by ballot cast by the Secretary, Messrs. Burns, Bequaert, Richardson.

The death of Mr. Otto Heidemann was referred to with regret by Messrs. Davis, Olsen and the President.

The Secretary exhibited Vol. 1, No. 1, of a new serial, The Lepidopterist, and the advertisement of a new maker of pin labels.

Mr. Shannon read a paper on "Autumn Migrations of Butterflies on Long Island," in which he gave precise data from personal observation of a strong westward movement of several species, among which the monarch butterfly (*Anosia plexippus*), was conspicuous, and an eastward movement of a few others, including *Callidryas eubule*. The paper will be published in full elsewhere; it elicited prolonged discussion in which Dr. Forbes, Dr. Bequaert and Messrs. Davis, Dow, Engelhardt, Wright, Olsen, Comstock, Watson and Bird took part. Mr. Shannon's facts were corroborated by the observations of Mr. Dow on the water between Long Island and Staten Island and by

entries in Mr. Davis's journal of flights observed on Staten Island. The enormous numbers of monarch butterflies congregated in limited areas, 10,000 or more in some instances, were mentioned by Messrs. Dow and Olsen. Mr. Davis noted that the eastward migrating species like *C. eubule* breed southward, while the westward moving species like *A. plexippus*, breed on Long Island and northward. He stated that *A. plexippus* does not hibernate on Staten Island though much worn specimens occur there in May.

His latest date for this species was November 25, 1894, one found at Tottenville, frozen to death.

Instances of unusual flights of many other species of Lepidoptera and Odonota were recalled and a number of explanations were offered; Dr. Bequaert mentioned similar flights observed in Africa where the forest makes the observation more difficult, Prof. Wright told of what he had noticed in southern California where the collecting was good at the end of a wharf $2\frac{1}{2}$ miles out at sea; Mr. Bird spoke of spring migrations across the Sound; Mr. Watson recorded larvæ of *C. eubule* found near Princeton on *Cassia marylandica*; Mr. Davis said *C. eubule* bred in numbers along the James River in Virginia and that the species reached Staten Island in its northward flight between September 15 and 20. Mr. Shannon told of having marked 1,000 *A. plexippus* by a peculiar cut in the wing in the hope of ascertaining thereby the extent of their flight.

Mr. Davis, referring to unusual appearances of hibernating butterflies said that it was in the latter part of March, 1907, when owing to the very warm weather all of the hibernating butterflies came out together. *Pyrameis atalanta* and *P. huntera* usually are later about waking up than some of the others. *Anax junius* hatched out or emerged at the same time. Later we had cold weather.

Mr. Davis, under the title "Interesting Insects from Staten Island," read a paper on *Ammodonus fossor*, which will be printed in full, and exhibited several boxes, illustrating among other things, dragon flies, cicadas and nut-weevils, drowned and washed up on Rockaway beach; *Cicindela dorsalis* caught at Long Beach, L. I., on September 21; his collection of *Vespa* as named by Dr. Love and Dr. Bequaert, including nests of *V. crabro* and *V. communis* made from live wood, and nests of *V. maculata* and *V. diabolica* made from dead wood; his remarks on the food of wasps elicited some discussion by which it appeared that while *Microbembyx* may use parts of dead insects, the Bembicidæ generally confine themselves to living insects.

Mr. Davis also showed ghost crabs from Old Point Comfort and Long Island, saying that they live several years in the south and attain great size, but apparently do not reach sexual maturity on Long Island, where they are always much smaller.

Mr. Nicolay exhibited *Buprestis connexa*, collected in the Blue Mountains, Oregon, by W. Chamberlain, August 6, 1914, on *Pinus ponderosa*.

MEETING OF DECEMBER 19.

A regular meeting of the New York Entomological Society was held December 19, 1916, at 8:15 P. M., in the American Museum of Natural History, President Harry G. Barber in the chair, with 25 members and a number of visitors, including Prof. J. S. Hine and Prof. E. E. Calder, present.

The president appointed as a Nominating Committee Dr. Lutz, Mr. Dickerson and Mr. Shefman.

Mr. Dow read a paper on "The Insect Progeny of Adam's First Wife" in which he reviewed the myth of Lilith, who, according to the Talmud, was the wife of Adam before the creation of Eve, but, leaving her husband, became the consort of Beelzebub and the mother of noxious insects. The analogy between Beelzebub, the Semitic lord of flies, and similar conceptions of other ancient nations was considered and numerous citations from Hebrew writings were given to illustrate that, as pointed out in previous papers on Zend, Sanscrit and Egyptian antiquities, it is the insects hurtful to man, like hornets, bees, flies, etc., that first attracted notice. In closing Mr. Dow traced the myth of Lilith through to modern times and mentioned some of the modern words derived from her name.

Dr. Forbes exhibited part of the Seifert collection and spoke of the evidence it presented of "Mendelian Variation in *Apantesis*." He first explained briefly the theory of Mendel and then illustrated it by the variations shown in the bred families of *phalerata*, *vittata* and *nais*, with the conclusion that mere breeding true is not a test of specific difference in *Apantesis*.

His remarks were discussed by Messrs. Angell, Weeks and Davis, the latter asking why the extensive breeding experiments of Dr. Seifert did not disclose more mutations.

Dr. Forbes pointed to a specimen with transparent hind-wing border area as a possible example of mutation; and the comparatively small number bred as the reason for there being no more.

Mr. Dow in this connection spoke of the work now in progress by Teetz and Mr. Olsen spoke of *Papilio glaucus*.

Mr. Wright read a paper, "Notes on Californian Lepidoptera," illustrated by many specimens of *Pherne vernalaria* and *Larentia switzeraria* and *swettaria* and their variations. He described some of his collecting places and spoke of the collectors and authors who have worked with Californian geometers; dwelling particularly upon the enormous numbers in which some species were obtained and their great variability, leading often to synonymy in descriptive work.

Dr. Forbes said that he had found the variability quite as great in some eastern species and gave instances of some errors due thereto.

Prof. J. S. Hine, upon invitation by the President, spoke briefly of his studies in Diptera and particularly Tabanidæ, which as carriers of disease in cattle, are become constantly of increasing economic importance.

MEETING OF JANUARY 2.

The annual meeting of the New York Entomological Society was held January 2, 1917, at 8:15 P. M., in the American Museum of Natural History, President Harry G. Barber in the chair, with 18 members and several visitors present.

The report of the Nominating Committee recommending the reelection of all the officers was read. On motion the nominations were closed and the Secretary cast an affirmative ballot, thereby reelecting the present officers.

The Entertainment Committee reported the acceptance by 53 visitors of the supper invitation, December 27, and a total attendance of 92 at that function.

The resignation of Herman Hug was read and accepted with regret.

The death of Dr. J. B. Knapp was announced and a minute expressing the regret of his fellow members is herewith entered.

Letters were read from W. Hague Harrington in reference to non-receipt of JOURNAL, which was referred to the Librarian, and from R. P. Dow, in reference to Green Brook and Alpine, N. J., and their preservation. The Secretary was instructed re the latter to write the chairman of the Palisades Park Commission, protesting in the name of the Society against further spoliation of natural scenery.

Dr. Bequaert exhibited a case of African wasps with maps illustrating their distribution and read a paper entitled "Color Varieties of *Eumenes maxillosus* and their Distribution" in which he said that the general conclusions derived from the study of African wasps received from the Lang and Chapin Expedition and other sources, might be useful in the study of American wasps. The color, though in some exceptional cases remarkably constant, was usually of less value than structure and sculpture as an index of specific identity; in many places the same coloration occurred in two distinct species and in one region the same arrangement of colors occurred in six different genera. The varieties of *Eumenes maxillosus* were discussed in detail, ten forms being included, though it was admitted that the single Australian form was more distinct than most.

Dr. Forbes, in discussing the paper, spoke of cases of similar coloration of Lepidoptera, usually attributed to mimicry.

Mr. Davis after mentioning a remarkable case of similar coloration in Cicadas of different genera, received from John Woodgate, cited the variable structure of the cerci of *Aptenopedes*, a character always regarded as indicative of species, as an instance of structure being, at least sometimes, as subject to variation as color.

Mr. Schaeffer gave instances of similar variation in sculpture, saying that considerable experience was necessary to detect the variable characters for each group.

Mr. Leng referring to similarity of coloration in different species being at times climatic, mentioned the tiger beetles of the Atlantic region, many species of which become more strongly maculate with white in the northern part of their range.

Dr. Forbes said the same was true of some Noctuids in which a green color indicated an eastern habitat.

Mr. Schaeffer said notwithstanding some objections his studies of our variable western *Eumenes* made it certain that too much reliance had heretofore been placed on color characters and he was fully in accord with Dr. Bequaert's views.

Mr. Leng read a paper, "Notes on New Coleoptera," and exhibited specimens of two new species of *Arthromacra*, a new variety of *Scaphinotus*, and an introduced species of *Syncalypta*, closing with a discussion of the synonymy of *Hymenorus* or *Mycetochara rufipes*.

His remarks were discussed by Messrs. Woodruff, Davis and Schaeffer.

Mr. Schaeffer exhibited a specimen of *Icsa austriaca*, taken by Mr. Engelhardt on Mt. Hood, Oregon, stating that this capture in conjunction with those previously recorded, established the indigenous character of the species.

Dr. Bequaert said he was probably correct and to facilitate the recognition of the species gave some characters by which it could be recognized, viz.: the short oculo-molar space by which the eyes almost reach the base of the mandibles and the upper side of the hind tibiae provided with long hairs.

Mr. Dow exhibited the following types and cotypes from his collection which he had presented to the American Museum of Natural History, viz.:

Cicindela anita, named in honor of Mrs. Annie Trumbull Slosson.

Cicindela marutha, named in honor of Mrs. Dow.

Cicindela ancocisconensis dowiana Casey.

Temnochila nyenta named in honor of our Society.

Mr. Woodruff exhibited the dragon fly, *Hagenius brevistylus*, and its remarkable pupa, which he had obtained from a mountain brook and raised to maturity.

Mr. Davis, commenting on the size and powers of flight of this dragon fly, said that it bothered the butterflies more than most birds.

Mr. Davis exhibited his remarkable collection of Chrysops flies, saying that a large proportion of the species of New Jersey were represented and correctly named for him by his Diptera-loving friends.

MEETING OF JANUARY 16.

A regular meeting of the New York Entomological Society was held at 8:15 P. M., January 16, 1917, in the American Museum of Natural History, President H. G. Barber in the chair, with twenty-one members and a few visitors present.

The Curator reported a donation of 24 spp. Odonata from Mr. Woodruff.

Prof. Edwin E. Calder, 4 Market Sq., Providence, R. I., was proposed for active membership by Mr. Leng.

The Secretary read a letter from Mrs. Abbie Fitch Andrews, presenting a photograph of Asa Fitch homestead at Fitch's Point, near Salem, N. Y.

The Vice-President taking the chair, Mr. Barber read his Presidential Address, devoted to a detailed consideration of the modifications of structures

in Hemiptera in adaptation to their several life habits, dealing in turn with the structures involved in feeding, locomotion and reproduction.

His remarks were discussed by Mr. Davis, Mr. Dickerson and Dr. Lutz.

Mr. Nicolay read a paper on "*Anthophilax* and other northern Cerambycidæ," which will be printed in the JOURNAL. His remarks were discussed by Messrs. Davis, Leng, Barber, Weiss and Dr. Forbes.

Mr. Weiss said that while *Rhododendron* leaves were not often attacked by beetles, the snout beetle, *Otiorhynchus sulcatus*, feeds on the foliage in the adult stage and on the roots in its larval stage.

Mr. Dickerson added that they might be trapped beneath boards.

Mr. Davis and Dr. Forbes commented on the gaps in the distribution of *Anthophilax*, which Mr. Leng said might be only apparent, due to the early date at which they appeared, according to Mr. Nicolay's data.

Mr. Davis, reverting to Mr. Dow's account of *Lilith*, Adam's first wife, exhibited females of *Automeris io* var. *lilith* and pointed out how little they differed from *io*.

Dr. Forbes said the difference was in the male and added: "You cannot be sure of females anyhow."

THE NEW YORK ENTOMOLOGICAL SOCIETY.

Organized June 29, 1892.—Incorporated June 7, 1893.

The meetings of the Society are held on the first and third Tuesday of each month (except June, July, August and September) at 8 P. M., in the AMERICAN MUSEUM OF NATURAL HISTORY, 77th Street and Eighth Ave.

Annual dues for Active Members, \$3.00.

Members of the Society will please remit their annual dues, payable in January, to the treasurer.

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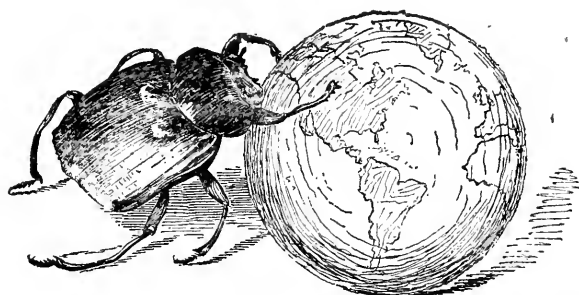
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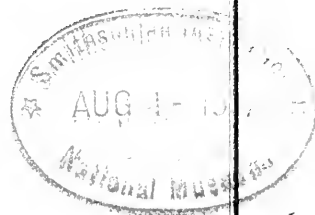
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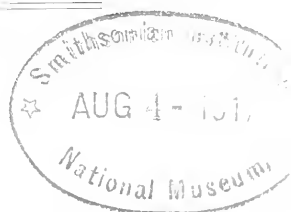
No. 2.

A FEW MEMORIES. II.

BY ANNIE TRUMBULL SLOSSON,
NEW YORK, N. Y.

It was in the early days of my interest in entomology that I first met Prof. A. S. Packard. The details of our meeting were somewhat amusing. I was at Enterprise, in Florida. My brother-in-law, Dr. William C. Prime, was with me, taking, as usual, much interest in my pursuits and collecting for me with earnestness and skill.

One afternoon when he came in from a fishing trip he told me he had met a man with a butterfly net looking for insects, and had a chat with him. With an amateur's conceit and self-satisfaction he had given the stranger some points and stated a few elementary facts in entomology. At parting the newcomer had presented his card and my brother produced it. Fancy my surprise when I saw the name of A. S. Packard for whom I, as a beginner, had unbounded reverence and admiration. When I exclaimed "Why that is the great entomologist. I have one of his books here with me now," the unconvinced tyro said: "Well, he did not act as if he knew much, took my hints gladly and thanked me for them." And this well illustrates the man's modesty and kindness. He was staying at the same hotel, the old Brock House, and there began a friendship between us which lasted the rest of his life. We went out together for a walk the next day. We were talking quietly, he telling me of meeting some friends of mine in Europe, and I speaking of their characteristics. Not a suggestion of anything entomological showed in our talk and



I, for the moment, had forgotten insect life and its interest when my companion started suddenly and quickly. Throwing back his left arm to prevent my advance—almost, in fact, pushing me back—he snatched a cyanide bottle from coat pocket, pulled the cork and rapidly, though stealthily, placed the mouth over a large moth resting with outspread wings upon the bark of a live oak near by. As he replaced the cork he said "*Bronchelia hortaria*, a fine specimen" and, almost in the same breath, "Do your friends still live in Boston?" this last question a continuation of the interrupted conversation of a few minutes back. This incident is also typical of his character. He was an accomplished, well-read man and could converse with charm upon varied topics, but he never wholly forgot his favorite pursuit. In the midst of talk upon literature, art, travel, a faint, almost hidden entomological allusion would rouse him to capture and hold it. He was a charming man, gentle, modest, utterly loyal in his friendships. When I returned home a few weeks after first meeting him I found a copy of his large work on the Geometridæ sent by him with a pleasant inscription on a blank leaf. We corresponded at intervals after that and often met, my brother's house being usually his home when he came to New York, and he often visited us at our cottage in the White Mountains. In July, '88, he wrote: "I am slowly collecting material for a monographic revision of the Bombyces and Zyganidæ, with special reference to the larval histories." "The great want now is colored drawings of the larval stages, from the egg up, of these groups, like those worked out so fully by Mr. W. H. Edwards for the butterflies."

I tried, with varying success, to help him in this. He was anxious for material for the life history of my *Ecpantheria denudata* but I failed to secure it. In his absence from home the eggs or larvæ of this species sent by me from time to time were not found by him till too late and he was much disappointed. His artist and friend, Mr. Joseph Bridgman took an enthusiastic interest in the work and I have many letters from him concerning his success or failure in raising material sent by me in Professor Packard's absence. Both were greatly interested in my finding in the larva of *Scirarctia echo* the "army worm" of the east coast of Florida where it was then very destructive locally. I sent some of the first eggs I could procure and as Dr. Packard was just about starting for Europe he handed

them over to Mr. Bridgham who wrote me as follows: "I separated the eggs into two lots and endeavored to retard their hatching as much as possible. One set I kept in as cool a place as I dared, and the rest in a room without heat. They *all* hatched however within a few hours of each other. Despite my efforts I lost many in the early stages, but have succeeded in raising fourteen to what should be their last stage before going into cocoon. They are very large and handsome. I feed them on lettuce and keep them constantly in the dark and in a large airtight box. They feed continually in the dark and the exclusion of air keeps the food from becoming dry, while there is yet sufficient air for their support." He then goes on to describe the larvæ briefly in the various stages and adds: "I have drawn them in six stages and shall add another figure life size." A fortnight later he wrote: "It is rather mortifying to have to confess that I did not succeed in bringing any of my larvæ to perfection. They fed well and grew large but failed to go into chrysalis." Mr. Henry Edwards and I were more successful, however, and our descriptions were published later.

In 1890 I took at Miami several specimens of a small white moth, quite new to me. I sent one of these to Professor Packard, who was much interested in it. He wrote later: "I have been working over the beautiful and most interesting moth you so kindly gave me. Have you the other sex, a female? Singularly enough the late Professor Poey gave me a female of an allied large species from Cuba and I would like to see a female of your species before publishing results. It is a new genus of Limacodid moths which I shall call *Eupaya*, naming your species *E. slossonia* if you will allow me. I have the cocoon of the Cuban form. It is snow white."

This moth was afterwards placed by Dyar in the genus *Calybia* Kirby. I am not sure whether it has remained there, for our insects are often wanderers with no abiding place in the changing world of catalogues and lists. Mr. Dyar studied the species in Florida from egg to imago and wrote an interesting paper concerning it, with illustrations in N. Y. JOUR. OF ENTOMOLOGY, Vol. V.

An amusing incident concerning his study of the species is not out of place here. I was in Florida while Mr. Dyar was there and he had showed me the curious larvæ feeding on mangrove and the chalky white cocoons. He left the place before I did, taking with

him several apparently full-grown larvæ and a quantity of the food plant. Some days after his departure as I entered the hotel after a morning of collecting the telegraph operator met me with a solemn face. Lowering his voice he told me that I would find a telegram slipped under the door of my room. Then he hesitated, and looking more and more solemn said in hushed tones: "I fear it brings bad news, something about a famine, I think." The dispatch read thus as nearly as I recall it, "Food nearly gone, fear they will die. Please send food at once, H. G. D." My mind was relieved; I hastened to explain matters to the sympathetic telegrapher and started out for the mangroves and nourishment for my starving namesakes.

Many letters passed between Dr. Packard and myself concerning an odd Bombycid moth which I took at Franconia. It somewhat resembled a *Cerura* and was always referred to in our letters as "the *Cerura*-like moth." It was seen by several lepidopterists but seemed new to all. One even thought it might be a noctuid near *Bombycia*. The good professor was intensely interested in the matter and finally, feeling he must solve the problem, wrote to me suggesting the denuding some of the wings of the moth to observe the venation. I had not been a scientist long enough at that time to accept this suggestion gracefully. I clung to my beautiful unique and urged its preservation. That its real name and proper place in the insect world might never be known made it even more interesting to me, and I said so, "speaking as one of the foolish women speaketh," as did, according to Scripture, the wife of long-suffering Job. Dr. Packard protested and persisted. He wrote May 5, 1892: "It is most interesting, can't be a noctuid, seems in most respects to be near *Gluphisia*. Now, as to the venation, by rubbing one fore wing a little on the under side I can make a camera drawing and thus settle satisfactorily, I trust, its position. If it were mine I should do this even to a unique as I don't believe in preserving specimens merely to look at. So I ask if you will let me rub off the scales, beneath, of one wing and await your reply." I could not resist the appeal, consent was given, the soft lining of one of my treasure's forewings removed, venation examined and the moth christened *Ceruridia slossoniæ*. It was afterward found to be a variety of *Gluphisia severa* Hy. Edw., but I believe is still thought worthy of a varietal name, my own, given by

the describer, I suppose, as a sort of reward for my meekness in the denuding matter. If Dr. Packard sometimes asked favors and sacrifices from his friends and fellow enthusiasts, he was, himself, always ready to make full return in the most generous, unselfish way. When he took my breath away by writing to me at Franconia: "My pressing wants just now are the eggs and larvæ of *Sciodonta*, *Lophodonta*—especially *Gluphisia*—also *Nerice* and *Prionia*; try to send them. Also I should like the larva of *Spilosoma congrua*, alive" (you will understand how easy it would be just to go out and procure these desiderata!), he would in the same letter beg me to call upon him freely for identifications, offer me perfect specimens of rare moths and show his loyal friendship in many ways. His was a most generous, unselfish nature. In all the years of our friendship I never heard him say an unkind word concerning another or even show sympathy with or assent to criticisms of fellow scientists uttered in his presence. I remember well one occasion when I spoke to him of an article then recently published in which the writer made allusions to some of the professor's work in a contemptuous and most unpleasant tone. I supposed Dr. Packard had already seen it, but he had not and asked for the magazine containing it. Such a pained expression came into his face that I thought he was deeply wounded at the unjust censure, and tried to show him that none of his many friends and admirers would allow their opinions to be affected by the article. "It is not that," he said, "the worst is that I'm afraid the man is right. I went into that matter too hastily, without sufficient research or study; that is my great fault always. I shall write and tell him this." And I have no doubt that he did so.

"How much American entomology," he wrote, in June, '92, "will miss Henry Edwards. I, myself, shall feel his loss sorely." I am glad I knew them both so well.

Dr. Packard died in 1905, just at the time I, myself, was passing through a great personal sorrow. In the very last letter he sent me, he wrote: "Do you and Dr. Prime go south next winter? I wish I could be with you there. I am just longing for soft warm air instead of the chilly winds of New England, for streams and woods and flowers, and, above all, the new truths I might find there in my—in *our*—favorite pursuit." I believe his longing is satisfied.

THE HEAD AND THROAT BOTS OF AMERICAN GAME ANIMALS.

BY CHARLES H. T. TOWNSEND,

WASHINGTON, D. C.

The bots here considered all belong to the genus *Cephencmyia*. The flies of this genus larviposit at the entrance of the nostrils or on or about the nose or mouth of various members of the Cervidæ, and probably at times of certain allied families of ruminants. The newly deposited larvæ gain entrance to the host normally through the nostrils, but no doubt also at times through the mouth. They cling by their spines and mouth-hooks to the mucous membranes near the point of entrance, and feed upon the mucous exudation which their irritation causes the membranes to secrete. On reaching second stage they penetrate farther within. The bots have been found in the following situations in the host:

1. *Nares*.—The nasal cavity is evidently the original habitat of the larvæ, whence they at times migrate or become dislodged and make their way to other nearby parts wherever they can find lodgment.

2. *Nasal Sinuses*.—Often infested and reached directly from the nares.

3. *Frontal Sinuses*.—At times infested and reached from the nares by way of the channel or grooved passage between the turbinated bones. This is the situation meant in the occasional reports of larvæ from the "brain cavity." The brain is evidently never reached.

4. *Eustachian Tubes*.—Reached through the posterior opening of the nares.

5. *Pharynx*.—Failing to become attached at the opening of the Eustachian tubes the larvæ, on emerging from the posterior opening of the nares, frequently find lodgment in the pharynx by securing a hold on its walls.

6. *Soft Palate*.—Reached on falling from the walls of the pharynx.

7. *Base of Tongue*.—Reached as in the preceding or directly from the mouth.

8. *Larynx*.—At times the larvæ, falling from the pharynx and

failing to secure a hold on either the soft palate or the base of the tongue, drop through the open epiglottis and become attached to the walls of the larynx between or beneath the vocal chords.

9. *Lungs*.—In some instances the larvæ lose their hold in the larynx and are compelled to pass down one of the bronchi, thus reaching the lungs. The only case of the kind on record is that mentioned by Brauer, in which a *stimulator* larva was taken from the lung of a roe deer in Europe (Wein. Ent. Zeit., V, 305).

10. *Gullet*.—Reached from the pharynx or mouth.

11. *Throat Pouches*.—Reached from gullet. The formation by the larvæ of these pouches or pockets in the throat constitutes a remarkable digression from the normal, and has evidently resulted from their efforts to escape being swallowed and passed into the stomach.

There are so far recorded from America only three species of this genus. One of these, *C. pratti*, is known in both the fly and third-stage larva. The others are *C. phobifer*, known only in the fly, and *C. macrotis*, known only in the third-stage larva, but it is highly probable that both are the same species. It is with the view of summing up the known facts and calling attention to the desirability of securing further material from all parts of the country that this article is prepared. By rearing the flies, and even by securing alcoholic larvæ from various sources, much can be done toward connecting the flies and larvæ of the same species and determining their range and host relations. The available records and the material so far known may be considered most conveniently in chronological order, as follows:

1815. One male fly collected by J. Abbott in Georgia was describer by Bracy Clark as *Æstrus phobifer*, the description being accompanied by an excellent figure (Essay on Bots, p. 69, pl. 2, fig. 30). The figure indicates the male in the comparatively narrow front, the wing venation leaves no doubt as to the genus, and the description is sufficiently clear for the identification of the species. It is known that Abbott lived somewhere between Savannah and Atlanta. Whether he secured this fly in the lower region or back in the hills is unknown but immaterial, as the host no doubt ranged in both districts.

1863. Two third-stage larvæ taken from throat of *Odocoileus*

hemionus Raf. (syn. *Cervus macrotis* Say), the mule deer, in the Northwest Territory, transmitted by Baron Osten-Sacken, were described and figured by Brauer as *C. macrotis*, the name being omitted from the description but inserted in the index (Mon. Œstr., pp. 211-212, 279, pl. IX, fig. 9). If there is any doubt about the validity of the name, it was formally applied and thus confirmed by Brauer & Bergenstamm in 1894 (Musc. Schiz., IV, p. 547). The only locality given by Brauer was North America, but Osten-Sacken supplied further details in 1878 (Cat. Dipt., p. 144). The range of the host in the old Northwest Territory was Minnesota, the Dakotas and western Iowa, which means that these bots came from somewhere in that region. The species will be readily identified on the larval characters given by Brauer. It seems very probable that it is the larva of *phobifer*. On larval characters it comes nearest to the European *stimulator*.

1863. Two or more third-stage larvæ taken from throat of *Cervus canadensis* Erxl., the wapiti or American elk, transmitted by Baron Osten-Sacken, were identified by Brauer as *ulrichii*, which is a European species (Mon. Œstr., p. 202). Again only the locality North America was given. The host originally ranged from Massachusetts to North Carolina and westward. Since the larval characters of *pratti* are closely similar to those of *ulrichii*, it seems practically certain that these larvæ from the wapiti were *pratti*.

1883. One or more larvæ taken from throat of *Odocoileus mexicanus* Gmel. (so stated but may have been *couesi* C. & Y.) in Durango were recorded by Brauer as belonging to this genus (Zweifl. Kais. Mus. Wien, III, p. 82). Brauer & Bergenstamm later applied the name *mexicana* to these larvæ (Musc. Schiz., IV, p. 547). The name is invalid, since it was connected with neither description nor figure. The species, however, is almost certain to be *pratti*.

1884. Three dozen or more third-stage larvæ, taken from *Odocoileus columbianus* Rich. by Dr. Charles H. Townsend in Shasta County, California, bear Smithsonian Accession 17956 and are *pratti*.

1889. Four third-stage larvæ taken from pockets or pouches in the throat of deer near San Jose, California, are *pratti*. This is the material referred to in Insect Life, I, 386-7.

1899. In July and August, I took large numbers of immature third-stage larvæ from the heads of many individuals of *Odocoileus*

coucsi C. & Y., in the Sierra Madre of western Chihuahua, near Meadow Valley, at about 7,000 feet, which were almost certainly *pratti*. They occurred principally in the nares and pharynx. No pockets in the throat were noted. It was common for a dozen or two to issue from the nostrils and mouth of the host soon after death. Unfortunately none of them was sufficiently mature for the rearing of the fly. The percentage of infestation of the host was very large. Messrs. Nelson and Goldman, of the Biological Survey, were in the same country at this time and noted the same bots commonly in the same host.

On several occasions I saw what I believe to have been the female flies of this species passing with incredible swiftness up and down over the stream in the head of the Rio Piedras Verdes canyon, near Meadow Valley. They flew high overhead, entirely out of reach, and were never seen to alight. About the only impression left by them on the eye was that of a blur or streak of orange or reddish and black, the red dominant. So far as could be judged from these fleeting glimpses, the flies were largely of a deep orange-red or rich red-brown, and seemed to be strongly piliferous. They appeared to be of good size, not heavy of body but rather long of legs, and very strong of wing. They were probably females looking for hosts. The females are somewhat larger than the males in this genus, and the impression of rather long legs was probably due to the extension of the legs below in flight. The pilosity of the extended femora, mostly black, helped to exaggerate the size. The males of the genus are usually met with only on bare mountain tops.

1903. One immature third-stage larva, taken by Mr. H. S. Barber from the nose of a blacktail deer at Bair's Ranch, on Redwood Creek, Humboldt County, California, June 17, is *pratti*.

1910. Eight third-stage larvæ were taken by Mr. F. C. Pratt, of the Bureau of Entomology, from nasal passages of *Odocoileus texanus* Mearns at Sabinal, Texas, in November. Three of these pupated, and two of the pupæ later disclosed male flies. From this material Dr. Hunter, in 1915, described the fly, third-stage larva and puparium under the name *pratti* (Proc. Ent. Soc. Wash., XVII, pp. 169-173, pl. XVI). Examination of the genitalia of the two specimens of the fly labeled allotype and holotype, described respectively as male and female, shows that both are males. The width of vertex

in the allotype is about one fifth of the head-width, in the holotype about one fourth. The abdominal pile of the allotype is nearly all deep black, while that of the holotype is practically all bright rufous, only the tip of abdomen showing a lighter pile mixed apically with black in both cases. I do not consider that these two specimens can represent two distinct species, notwithstanding the differences in frontal width and pile coloration, since they issued from puparia which appear to be identical. Moreover, they came from a lot of eight larvæ all evidently the same species. They simply furnish an emphatic illustration of the scope of variation in the species of this genus.

C. pratti is distinguished from *phobifer* practically only in retaining the mesoscutal band of black pile and losing the infusate area of the wing, in both points conforming to the European species. It differs from the European *stimulator*, which it closely duplicates in appearance, by the narrow front of male, short discal abdominal pile, and the restriction of the light pile of femora to the basal region, in all three points conforming to *phobifer*. The larval characters in general approach closely those of *ulrichii*, as stated by Hunter; the anal stigmata, one of the best specific guides, being practically the same. This explains Brauer's determination of the larva as *ulrichii*.

1913. Two flies were taken by Mr. Frank E. Watson, one on the summit of Mt. Marcey, New York, 5,344 feet, on July 3, and the other at North Elba, New York, in July. The latter specimen has been donated to the U. S. National Museum by Mr. Wm. T. Davis and is a male of *phobifer* (syn. *abdominalis* Ald.). Mr. Davis published a note on these two specimens in 1916 (JOURN. N. Y. ENT. SOC., XXIV, pp. 92-93).

1914. Three male flies taken by Mr. Wm. T. Davis on White Face Mountain, in the Adirondacks, New York, were described by Dr. J. M. Aldrich in 1915 as *abdominalis* (JOURN. N. Y. ENT. SOC., XXIII, pp. 145-150, pl. 11). This was the first record to be published on *Cephcnemyia* flies of American origin since Bracy Clark's time, and was of unusual interest as indicating the rediscovery of *phobifer* after a lapse of just one hundred years. It emphasizes the rarity of the capture of these flies. Clark's description and figure seem to leave no doubt of the identity of the species. The available data indicate quite positively that the discal abdominal pile of Clark's specimen was

dark, evidently blackish or brownish, that of the tip of abdomen being rufous. Even were the discal abdominal pile of Clark's specimen more or less rufous it would not militate against the reference of the New York flies to *phobifer*, for it appears certain that the color of the pile in this genus varies at times in the same species from pale yellowish and rufous to deep black. The absence of the mesoscutal band of black pile is unique. Above all, added to the other points of agreement, I consider that the peculiar area of wing infuscation, which is also unique, clinches the identity of *abdominalis* with *phobifer*.

C. phobifer is to be distinguished from the European *trompe*, which it almost exactly duplicates in appearance, by the narrower front of male, loss of the mesoscutal band of black pile, restriction of light pile of femora to basal region, shortness of abdominal pile, and infusate wing-area. Its distinction from *pratti* has already been pointed out.

1914. Seven third-stage larvæ taken by Mr. J. J. Rauers, March 27, from "brain cavity" (probably frontal sinuses) of a deer on the game preserve of St. Catherine Island, Georgia, form No. 17321 of B. A. I. Parasite Collection and are *pratti*. I am indebted to Dr. B. H. Ransom, of the Bureau of Animal Industry, for the opportunity of examining this material. This locality is on the coast just south of Savannah. It seems, therefore, that the range of *pratti* extends from the Pacific coast and southwestern regions eastward through the Gulf coast region to the south Atlantic coast of the United States.

1915. Two dozen or more third-stage larvæ, taken by Mr. J. S. Ligon, in February, in the larynx of a male *Odocoileus hemionus* Raf., at Aragon, Socorro County, New Mexico, are *pratti*. I am indebted to Mr. E. W. Nelson, chief of the Bureau of Biological Survey, for the opportunity of examining this material. The larynx was excised, with the bots in situ, and sent in alcohol. About a dozen of the bots were still massed within it, attached more or less firmly to the mucous lining of its walls. The locality is in extreme western Socorro County, on the Rio Tularosa near Old Fort Tularosa, and is mapped by Bailey as Upper Sonoran.

The above records cover all the references and material available to me on *Cephenemyia* of American origin. The Patagonian species described by Guerin as *grandis* is not this genus, but either *Rogen-*

hofer or a new genus. It is evidently a subcutaneous bot, and not a head or throat bot.

The larvæ recorded in *Insect Life*, II, p. 116, from nasal passages of man in California are third-stage screw-worms, *Cochliomyia macellaria* Fab. I have examined the material, which is now in the U. S. National Museum.

The larvæ from the throat of hogs near Parkersburg, West Virginia, recorded in *Insect Life*, III, pp. 161-162, are not *Cephenemyia*, nor are they any other known æstrid genus, nor yet screw-worms, Sarcophagids, nor Muscids (Calliphorids). The material, now in the National Museum, consists of a single immature third-stage larva of decided æstrid aspect, with double mouth-hooks and elaborately sinuous anal stigmatic slits.

It is evident from the foregoing that our knowledge of *Cephenemyia* in America is extremely defective. The flies themselves are seldom met with and usually difficult to capture. The male flies especially frequent mountain tops and collectors who visit such places would confer a great favor by capturing them. While they fly with extreme swiftness, they are at times found resting in sunny places. The female flies are less often found on mountain tops but frequent the haunts of the host. It appears that the only practicable way of securing them in the open is to shoot them with .22 caliber cartridges loaded with dust shot or fine sand. No American female flies are yet known in collections.

Occasionally other ruminant hosts than *Cervidæ* may be attacked by the flies of this genus. I have recently secured authentic information of bots in the heads of the pronghorn antelope, *Antilocapra americana* Ord, which is of extreme interest in this connection. Mr. Otto Schoenberg, superintendent of the Cedro Ranger Station, Manzano National Forest Reserve, who spent twelve years with the Apaches in Arizona, tells me positively that he has taken large bots from the nasal cavities of the antelope in central Arizona years ago. This is the first record of the kind known to me, and I consider the authority unquestionable.

The greatest service can be rendered by persons who have opportunity to examine fresh game heads in whatever locality. The best chance of finding mature larvæ, from which the fly can be reared, appears to be in winter or early spring. Mature bots from the heads

and throats of all possible wild ruminant hosts are greatly to be desired. Such hosts are the various deer, wapiti, various caribou, moose, all belonging to the family Cervidæ; and pronghorn, various mountain sheep, Rocky Mountain goat, musk-ox, belonging to other families of ruminants. The bots should be sent alive, packed in loose dry earth in tin receptacles.

NOTES ON LEPTOBYRSA RHODODENDRI HORV.

BY EDGAR L. DICKERSON,

NUTLEY, N. J.

The writer has been interested in observing this insect in New Jersey during the past few years and presented a brief paper on its development and habits at the fifth annual meeting of the Entomological Society of America in December, 1910. Recently the synonymy of this species has been noted in the Entomologist's Monthly Magazine and it seems opportune therefore to bring this to the attention of American entomologists and to record some additional notes on this insect.

The species, which was redescribed by Heidemann under the name *Leptobyrsa explanata* (Proc. Ent. Soc. Wash., X, p. 105-108, 1908) and which has been considered under the latter name by American collectors, was first described by Horvath as *Stephanitis rhododendri* in 1905 (Tingitidæ Novæ et Minus Cognitæ e Regionæ Palearctica in Ann. Mus. Hung., Vol. III, p. 556). As this description may not be available to some of our American students I include it herewith: "Pronoto elytrisque hyalinis, pallido-reticulatis et pilis brevibus erectis griseis sat dense obectis: capite nigro, buccubis albidis, fere ubique æque altis et antice ultra apicem tyli prominulis; antennis albido testaceis, brevissime pilosulis, articulo ultimo apicem versus nigro, pronoto disco brunneo, utrinque prope vesiculam anticam nigro, lateribus foliaciis late explanatis, irregulariter quadriseriatim areolatis, vesicula antica oblongo-elongata, sat humili, carina mediana quam vesicula antica haud vel parum altiore, carinis duabus lateralibus antice vesiculam anticam attingentibus: elytris abdomine multo longi-

oribus et latioribus, apice divaricatis, membrana costæ latissima, basin versus triseriatim, dein quadriseriatim et nox pone medium quinquiseriatim areolata, ante medium macula transversa subtriangulari nigricante notata, vesicula discoidali parum elevata; corpore subtus nigro, lobo postico prostethii maculisque pectoris ad coxas pallidis; pedibus albido-testaceis, tibiis apice et tarsis levissime infuscatis. ♂ ♀ Long. $3\frac{1}{2}$ – $3\frac{3}{4}$ mm. Hollandia: Boskoop in *Rhododendris*."

In his paper Heidemann states: "This new species seems to be most correctly placed in the genus *Leptobyrsa* which was founded by Stål on a single species (*Tingis stenii*) from Rio Janeiro, Brazil. It also has much affinity with the genus *Stephanitis* Stål, but the hood is comparatively smaller and the lateral carinæ extend over the whole length of the pronotum, not abbreviated in front."

Heidemann describes the first two nymphal stages briefly and the last one in detail, the egg and its position, the time of oviposition and emergence. *Kalmia* and *Rhododendron* are given as food plants, a number of localities are noted and Rock Creek, D. C., given as the type locality. It is interesting to note that among the records is one from the Uhler collection, Lehigh Gap, Pa., 1877. The distribution recorded is from Boston to Florida and as far west as Ohio. A nymph and adult are figured.

In the Zoologist, 4th Series, 14, 1910, p. 395, W. L. Distant states that he has received specimens of this species from a grower of rhododendrons at Fulham and that Dr. Horvath suggests it has been imported into Europe. He, Distant, erroneously concludes "that it has been introduced from India, it being well known that the headquarters of the genus *Rhododendron* is in the Himalayan region and four species of *Stephanitis* are already recorded from British India." He figures the adult and the last nymphal stage.

In the Entomologist, September, 1916, E. Ernest Green, Way's End, Camberley, records this species, recently introduced into England infesting rhododendrons. G. C. Champion adds a further note, citing the above references and stating that *S. rhododendri* Horv. and *Leptobyrsa explanata* Heidemann are without doubt the same species. He suggests that the "Eastern States of North America and not India are the home of this insect," and states that this insect would be better placed under *Leptobyrsa*.

In the *Journal of Economic Entomology*, Vol. 8, No. 4, pp. 409-414, C. R. Crosby and C. H. Hadley, Jr., give an account of this species, mentioning distribution, food plants, injury, and control measures and describing the eggs and their location, and the various nymphal stages. The various stages of the insect, injury and eggs in position are illustrated.

As noted in this paper and also by Heidemann this species inhabits the undersides of the leaves and by feeding causes a light mottled spotting on the upper surface. In addition the under surface of the leaves are more or less disfigured with numerous minute dark spots of a dark varnish-like excreted material.

The egg is somewhat irregular, cylindrical and flask-shaped, or in general outline oval, with a rather broad, neck-like elongation at the outer end turned to one side as shown in the figure. It measures about .4 mm. long and is pale yellowish white. These eggs are inserted in the lower surface of the leaf obliquely toward the midrib with the truncated end of the neck-like portion extending slightly above the surrounding surface (Plate VIII, fig. 6). The egg is capped with a varnish-like material which later becomes dry and hard and sometimes drops off before the egg hatches. This cap has a lighter outer rim and an inner darker portion which is very slightly more protruding. "The tissues surrounding the egg becomes hardened and corky but this hardening is entirely internal and makes no noticeable change on the surface of the leaf." The eggs are usually placed along the midrib and where several of them occur in a row, as is often the case, they are easily seen due to the varnish-like material that covers them. Occasionally they are placed along the side veins a short distance from the midrib and in a few instances I have observed them 5.5 mm. distant from any vein. The number of eggs counted in one badly infested leaf totaled 176, about equally distributed on either side of the midrib, and several other leaves examined appeared to contain fully as many. The number laid by a single female was not ascertained. In ovipositing, the female rests with the body parallel to the surface and with the ovipositor extended from the sheath, extending posteriorly and ventrally into the leaf tissue.

The various stages of the insect have been previously described, as already noted, and need not be redescribed here. The interesting point is that there are only 4 nymphal instars, the insect thus differ-

ing from some of our common species, which have 5 nymphal stages, Crosby and Hadley give the duration of the nymphal stages under insectary conditions as follows:

“First stage 6 to 7 days,
Second stage 4 to 6 days,
Third stage 3 to 6 days.
Fourth stage 12 to 15 days.”

This would give a minimum time of 25 days and an average of 30 days. In New Jersey development appears to be even shorter, at least in some cases, and more rapid on those plants exposed to full sunlight than on those in the shade. In one case some insects emerging May 10 reached maturity by May 30. The day's durations for the various nymphal stages were 5, 4, 3, and 7, giving a nymphal period of 20 days, other individuals requiring a longer period. During the first three nymphal stages the insects appear to move very little, remaining grouped close together, feeding on the undersides of the leaves. I have observed the insects feeding on the opposite side of the midrib from the cast skins. In the fourth or last nymphal stage there seems to be decidedly more movement. In feeding, it might be noted, the lancets are extended from the sheath of the beak, the latter doubled on itself with the tip helping to guide the lancets. The winter is passed in the egg stage. “At Ithaca, N. Y., the eggs hatch in late May or early June. . . . They have been observed hatching out of doors on June 6 and had apparently all hatched by June 17.” At Rochester, N. Y., young nymphs have been observed May 25. In New Jersey development begins somewhat earlier. In 1911 in the vicinity of Newark nymphs began hatching May 10, while in other seasons emergence begins nearer the first of that month and in the southern part of the state undoubtedly in the latter part of April. Near Washington, D. C., Heidemann records finding young nymphs and unhatched eggs April 20.

The number of broods seems to vary. Usually I believe there are two broods in New Jersey. The nymphs begin emerging early in May and reach maturity early in June and by the middle of that month or shortly after all the insects of this brood have matured. After feeding and copulating oviposition occurs and may continue through June and part of July. Insects of this as well as other species

of Tingids have been observed in copulation. These individuals rest side by side, the bodies forming an angle of about 95 degrees and the abdomen of the female dorsal to that of the male. From these eggs a second brood of adults emerges in August. Nymphs of this brood have been observed at Springfield, N. J., August 23, nymphs in all stages and adults at Somerville, N. J., August 21, and in Cumberland County, N. J., September 2. Adults in small numbers were still present on badly infested plants in the northern part of the state on September 29. Adults of this brood oviposit the hibernating eggs.

On the other hand I have observed near Newark, N. J., infested plants where there was only one brood. Adults began to mature in early June and continued to appear until shortly after the middle of that month and continued in evidence through July; no hatching of eggs occurred in August and hence there was only one complete brood.

In this connection it is interesting to note what Mr. Van den Broek and P. J. Schenk say concerning the insect in Holland (Zeitken en Beschadigingen der Tuimbouwgewassen, p. 170), *Stephanitis (Tingis) rhododendri*. Insects pass the winter in egg stage. In May or later the eggs hatch and it takes about three weeks to complete its development. Not all the eggs hatch at one time apparently, as nymphs are still found at the end of July and in the beginning of August. The insects disappear at the end of summer.

An examination of the adults reveals some interesting structures including those associated with the reproductive system.

In the male the extremity of the body appears somewhat elongate due to the character of the apical segment. This is narrower and longer than the other abdominal segments and normally rests with its base somewhat retracted within the penultimate one. It may also be designated as the genital segment since it bears the reproductive organs. On the dorsal side (Plate VIII, fig. 1) there is a concave posterior margin just before which, laterally, is noted a slight covering of short hairs. From beneath this margin there projects a pair—one on each side—of comparatively large falcate claspers which are sparingly covered with hair at center, especially on the inner side. Between these claspers and also projecting from beneath the central part of the margin is the penis, resting within a thin chitinous sheath, which is elongate and truncate with parallel sides and bears

a number of short hairs near the apical end. Just beyond the extremity of the lateral margins of the penis sheath there is on each side a pair of small openings or pores on the dorsal surface. The posterior one on each side is slightly interior to the anterior one and is oval in outline, while the anterior one is circular. Between these two pairs of pores a small number of minute hairs can be distinguished. Viewed from the ventral side (Plate VIII, fig. 2), the posterior margin of this apical segment is observed to be broadly rounded and slightly sinuate and to extend beyond the dorsal posterior margin so that only a small portion of the claspers is visible when the latter are in their normal resting position. Before this posterior margin, laterally are small areas of anteriorly directed short hairs.

In several common species of Tingidæ that I have examined I find that claspers similar to those here noted are borne on the genital segments of the males.

In the female, the apical end of the abdomen is broadly rounded. On the ventral side is situated the ovipositor (Plate VIII, fig. 3). This originates with its base below or within the antepenultimate segment and extends posteriorly with the tip resting in the apical segment and the whole inclosed in a groove closely fitted to it and open along the center line. One pair of membrane-like edges meeting along the center cover and enclose the ovipositor from the base of penultimate segment to the apex of the abdomen, while a second and similar covering overlays this one in the penultimate segment. This second covering may be considered as a paired outfolding of the chitinous membrane of this segment which has been pressed over so as to meet in a line extending over the ovipositor. The position of the ovipositor in its groove and the covering membranes may be better understood by noting the cross-section view.

The ovipositor as seen in cross-section (Plate VIII, fig. 4) consists of two parts, an upper u-shaped piece and a lower paired piece. The upper piece is thin at the top with its side parts broadening out and having each on their ventral surfaces an acute ridge. The paired parts of the lower piece are somewhat triangular in outline with a groove in the dorsal side of each which fits the acute ridge of the side piece of the upper part of the ovipositor. The two parts of the organ are thus able to move on one another. The paired pieces of the lower part, moreover, are united by a thin membrane which ex-

tends upward between the two sides of the upper piece. Thus there is formed by the upper piece and the lower side pieces and their connecting parts an oviduct which extends from the base for two thirds the length of the ovipositor beyond which point the membranes connecting the side pieces are divided.

Viewed from the side (Plate VIII, fig. 5) it is observed that the ovipositor gradually tapers from the base to the apex. The upper part is smooth save toward the apical end where it becomes somewhat serrate with an acute apex. The two lower side pieces are strongly transversely ridged from base to apex. The possession of an ovipositor by the female is related of course with the habit of this species of ovipositing in the leaf tissue.

As noted in Heidemann's description of the adult "the entire lateral margins of the pronotum, crest of hood, carinae, and most of the nervures are beset with long very fine hairs." In this respect this species is quite different from some of the commoner species of the Tingididae which I have examined. In these latter the hairs on the nervures, etc., are variable but spine-like and very few in number. In this species they are comparatively fine and long approximating in length the width of the medium-sized areoles and on the upper surface are more or less erect (Plate VIII, fig. 7). They also occur in somewhat smaller numbers on the undersurface of the elytra where they are distinctly inclined.

Another interesting structure noted in cleared and mounted specimens is a mass of small papillae-like structures. There are two such masses, one on each side, within the first abdominal segment.

This species infests the rhododendron and mountain laurel (*Kalmia latifolia*). Heidemann records it from both of these plants and I have found it infesting them in New Jersey. In the nurseries it occurs mostly on the rhododendron, especially *Rhododendron maximum*, and while some varieties seem to be freer from infestation than others this exemption may be more apparent than real. Van den Broek and P. J. Schenk (*c. c.*) state: "This species has been found in 120 varieties of rhododendron, azaleas, and *Kalmia latifolia*."

While Heidemann gives the distribution from Massachusetts to Florida and westward into Ohio, the insect will undoubtedly be found even outside this area where rhododendrons have been planted, owing

to its liability of being distributed on nursery stock. It is a native American species and evidently introduced into Europe on rhododendrons exported from America. It is reported from Holland and England and may occur in adjacent countries where rhododendrons are grown. The eggs have been found on rhododendrons received in this country from Holland and England.

EXPLANATION OF PLATE VIII.

- Fig. 1. Apical segment of male showing claspers, and dorsal surface.
Fig. 2. Same, ventral surface.
Fig. 3. Ventral surface of female showing ovipositor in position.
Fig. 4. Cross section (at *A-B*, fig. 5) of ovipositor.
Fig. 5. Lateral view of ovipositor.
Fig. 6. Egg in situ.
Fig. 7. Portion of hemielytra showing hairs on dorsal surface.

LIFE HISTORY OF A BOATMAN.

BY H. G. HUNGERFORD,

ITHACA, N. Y.

The rearing of aquatic Hemiptera appears to have been attended with unusual difficulty, and, for this reason, little has been known regarding the life histories of some of them.

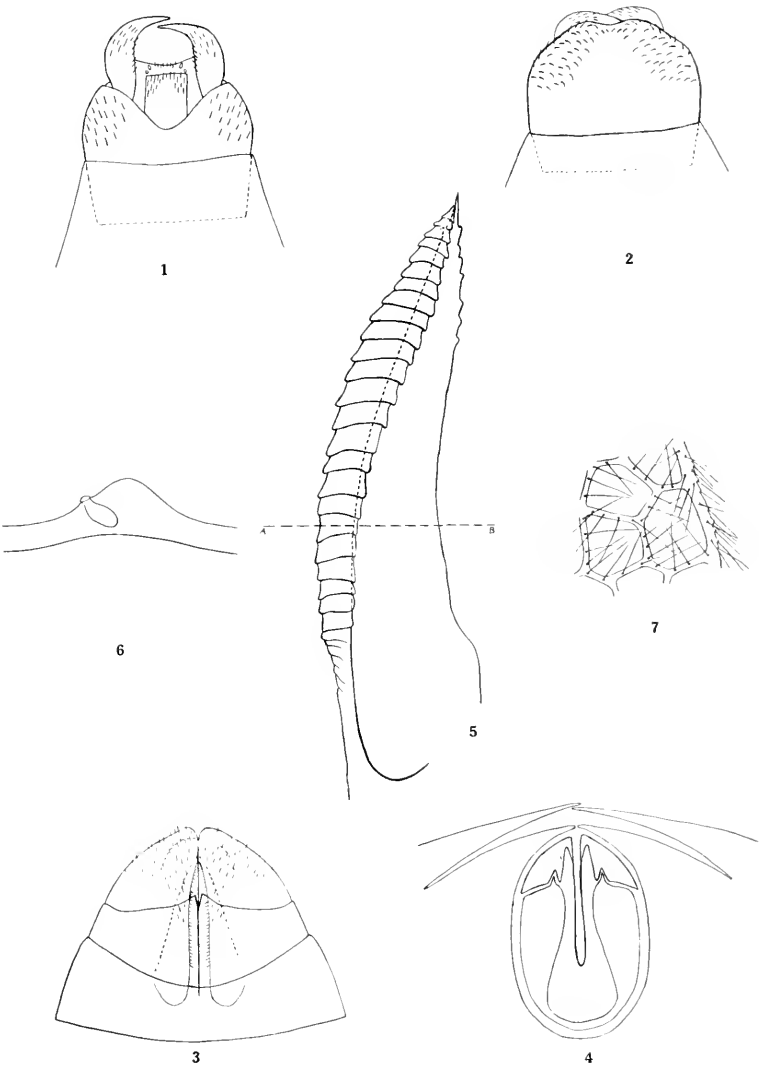
However, the fact that our information concerning some of the aquatic bugs has been meager, has not been due to a neglect on the part of our best known workers in this group. For Dr. Kirkaldy, Dr. Abbott, and Mr. de la Torre Bueno have endeavored to provide the much needed information.

The late Dr. Kirkaldy, though a taxonomist primarily, experimented with this phase of the problem. Mr. de la Torre Bueno,¹ who has added more to our knowledge of the life histories of American water bugs than any other, has called attention to the obstacles involved.

Among the most difficult of the aquatic insects to rear have been the water boatmen. Dr. Abbott,² our authority in this group, suc-

¹ Can. Ent., X, 1912: p. 113.

² *Ramphocorixa balanodis* Abbott, Can. Ent. XXXI, p. 113.



Leptobyrsa

ceeded in rearing *Ramphocorixa acuminata* Uhler. He did so, however, by placing them in a very large aquarium used for breeding mussels. "This was a zinc lined tank about two feet deep, and with a superficial area of thirty or thirty-five square feet, with a layer of soft mud in the bottom of an overflow arrangement by means of which a quiet but constant stream of fresh water was kept circulating through the tank."

His attempts in confinement failed and he was inclined to attribute these failures to the absence of proper food which he supposed to be Ostracods, or similar organisms.

Thus it has happened that until recently the factors necessary for the continuous maintenance of certain forms throughout their developmental lives have remained unknown. However, when the conditions have been discovered, the problem becomes somewhat less difficult.

In a paper on "The Food Habits of Corixids"³ the writer has pointed out the reason for the failure to rear them in ordinary aquaria. The source of the food supply of the boatmen lies in the brownish sedimentary material at the bottom of the pool, and when this is furnished in fresh supplies each day, they may be reared in remarkably close quarters. The species here described were reared in shallow glass petrie dishes, eleven centimeters in diameter, as many as twelve individuals in each petrie dish. It will thus be noted that they do not destroy one another after the manner of their fierce predatory neighbors.

Our experience with these has shown that they must receive careful attention; the neglect of a day or two will result in disaster, and it has been our custom to visit the pool for fresh corixid food daily.⁴

The adults are said to pass the winter in the mud at the bottom of the pools and this year were aroused to activity during the warm days of February.⁵ The eggs were laid, in the laboratory, on bits of

³ Journ. N. Y. Ent. Soc., XXV.

⁴ Two broods were reared in ordinary glass aquarium jars, 14 inches in diameter, in which there had been cultures of *Nitella*, without receiving any attention other than adding water occasionally.

⁵ The adults are more or less active in open water any time during the winter. They were taken in numbers at Ithaca, N. Y., January 10, in a spring-fed pool.

cottonwood leaves placed in the aquarium for the purpose. The leaf bits were then transferred to petrie dishes where a careful study of them with the binocular was possible each day. The eggs are laid on the dead leaves and stems of plants lodged in the water. We have found as many as seventy-four eggs on one cottonwood leaf.

There are several generations a year and the eggs of the summer generation are often found on floating weeds and any other available support in the water. The writer has found the eggs of this species, of a small undetermined species, and even those of *Rhamphocorixa acuminata*, which has a peculiar tendency to attach its eggs to the carapace and abdominal pleurites of crayfish, covering tin cans lodged in the water, boards, floating and attached, and even to the shells of living snails. Sticks of log wood of various sizes are sometimes so covered with the eggs of this corixid of the summer generation that it is impossible to handle them without destroying hundreds of eggs.

THE OVUM.

Shape.—The shape of the egg of this species resembles a wooden top, such as the American boy keeps. It sits upon the button end in a disc of leathery material. Eggs of a somewhat similar shape are figured by Metschnikoff, and have been described as pyriform.

Color.—The color, when first laid, is pearly white. This gradually changes to a deep yellow. The red eye spots show very plainly in the more advanced stages. These spots begin to appear about the fourth day as rather indefinite pink patches which gradually darken to a deep red, by which time they then have assumed definite and characteristic shape.

Size.—The greatest length is .581 mm. The greatest diameter is .520 mm.

The egg of this species is figured in Plate IX.

The eggs of two other species are drawn to show the difference in shape, and relative size.

FIRST INSTAR.

Size.—General measurements:

	Mm.
Width of head .....	.50
Greatest abdominal width .....	.58
Length of body	1.17
Specific measurements:	

	Femur.	Tibia.	Tarsus.	Claw.
Prothoracic leg .....			.222	
Mesothoracic leg .....		.249	.291	.332
Metathoracic leg .....	.291	.291	.533	.249

Color.—When newly hatched, the color is transparent white, the red eyes possessing the only conspicuous coloring matter. The nymph darkens gradually with age, coming finally to a mottled brown, of rather indefinite pattern.

Structural Details.—The nymph appears exceedingly flat. The abdomen is fringed with lateral spines, which on the lateral margin of the last four segments, are quite regularly arranged. There are four spines of unequal length on each. First, a comparatively short spine which is followed by one somewhat longer, and this, in turn, is followed by a long spine, immediately caudad of which, at the latero-caudal point of the segment is a very small spine. On the dorso-lateral surface near the rear margin of each segment is to be found a fine hair. The caudal end of the abdomen bears two short spines, and several pairs of long ones. The eyes are relatively small in comparison with the width of the head. In later instars they become increasingly large as the nymph advances. This point has been noted by Dr. Abbott in the case of *R. acuminata*.

The limbs are more clumsily set up than in the more advanced nymphs; especially is this true of the forelegs. Here the pala is studded with tiny pegs on its inner surface and equipped with the characteristically strong spines and long bristles of the older form. The pegged depression on the inner face of the pala occupies but the outer half of the segments, as shown in the sketch of fifth instar leg, Pl. IX, fig. 10. Compare this with that of the adult, Pl. IX, fig. 12.

The mesothoracic legs are angular limbs, terminating in two long, slightly incurved claws which are larger than the tarsus itself. They are sparsely clothed with bristles. The metathoracic limbs end in long tarsi. They are fringed with about two dozen long hairs in one row, and further equipped with two rows of stiff short spines. The tarsi terminate in a pair of long slender claws, about one third as long as the tarsus itself (see fig. 6). The tibia is slightly thicker than the tarsus and is clothed in a few stout bristles arranged in rows. It is provided near the distal end with a pair of longer bristles,

and a pair of long hairs arranged along the posterior margin of the segment near its base. The femur is somewhat stouter than the tibia and nearly free from spines, though possessing a few slender hairs on its anterior margin. (See fig. 4.)

SECOND INSTAR.

Size.—General measurements:

	Mm.			
Width of head .....				.75
Greatest abdominal width .....				.90
Length of body				1.63 to 1.78
Specific measurements:				
	Femur.	Tibia.	Tarsus.	Claw.
Prothoracic leg .....			.291	
Mesothoracic leg .....	.249		.333	.333
Metathoracic leg .....	.457	.400	.625	

Color.—The general color is arranged in a more distinct pattern than that of the first instar, though not as pronounced as in the next instar. The abdomen is crossed by dark lines, following the point of union of the segments. This banding conspicuously marks the second from the first instar and, in a petrie containing a number, at once distinguished a moulted form from those still in their first stage.

Structural Details.—Much as in previous instar. The lateral spines are now arranged in a different way. Long spines alternating with short ones, five or more to each segment.

The rear margin of the mesothorax is now indicated by a line arcuated as shown in the drawing. (See Pl. IX, fig. 5.)

In specimens about to transform to third instar, the hairs fringing the thorax in the next stage are visible beneath the covering.

THIRD INSTAR.

Size.—General measurements:

	Mm.			
Width of head				1
Greatest abdominal width				1.25
Length of body				2.3
Specific measurements:				
	Femur.	Tibia.	Tarsus.	
Prothoracic leg .....		.372	.498	
Mesothoracic leg	1.16	.526	.498	
Metathoracic leg .....	.66	.623	.919	

Color.—The brown color is mottled with markings of gray patches regularly arranged. The black fringe of hairs on the thorax at once marks it from the second instar. Fourth longitudinal bands of light blotches mark the definite pattern on the abdomen.

Structural Peculiarities.—The appearance of the hairs on the thorax as mentioned above and shown in the drawing, Pl. IX, fig. 7, is its most distinctive feature. These fringes enmesh the air and provide a reservoir by means of which the nymph is able to carry below an air supply.⁶ It is this instar that the corixid first manifests much concern regarding its air supply. But from this stage on, frequent adjustments of air store are effected. The metathoracic tibia possesses in all the instars a characteristic depression on the rear margin. This is guarded by hairs and appears to be used in this and later nymphal instars to transfer the air held by the hairs on the wing pads and behind the head shield to other portions of the body. It will be noted that the wing pads, which are covered with a pile of short hairs, do not surpass the metathorax. Compare the drawings of this with those of later instars.

The fore femur and tibia are stouter than any of the other limbs, especially the tibia, which is more than half as wide as long.

The mesotarsal claws are still longer than the tarsus itself. The spines on lateral margin of the abdomen are now more numerous than in previous instars, and there are two pairs of short spines on caudal margin of the abdomen.

FOURTH INSTAR.

Size.—General measurements:

	Mm.
Width of head	1.25
Greatest abdominal width	1.62
Length of body	3.5

Specific measurements:

	Femur.	Tibia.	Tarsus.
Prothoracic leg .....			.684
Mesothoracic leg	1.25	.706	.381
Metathoracic leg .....	.872	.587	1.41

⁶ For a full account of respiration of a Corixid see Johannes Hagemann's paper "Beiträge zur Kenntnis von Corixa" in: Zoologischen Jahrbüchern, Bd. 30, 1910. (Abt. f. Anat.)

Color.—As in the previous instar, but conspicuously darker on thorax, due to the presence of larger wing pads which are fringed with black hairs and covered with a short pile of dark hair.

Structural Details.—The wing pads now extend a little past the thorax and cover at most a third of the first abdominal segment as shown in the drawings.

The hairs on lateral margin of the abdomen are now too numerous and profuse to be characterized.

It may be noted here that the basal half of the fore tibia, as in previous instars, is equipped on its inner margin by a definite patch of minute hairs, reminding one of a part of a tonal device figured by Dr. Abbott.

FIFTH INSTAR.

Size.—*Size.*—General measurements:

	Mm.
Width of head	1.75
Greatest abdominal width	1.75
Length of body	4.375
Specific measurements:	

	Femur.	Tibia.	Tarsus.
Prothoracic leg .....		.618	.787
Mesothoracic leg	1.57	.913	.664
Metathoracic leg .....	.996	.996	1.66

Color.—Due to its size, the pattern is now distinct, though the same arrangement as in former instars. The abdomen has four broken longitudinal lines, plainly marked, and a faint median line. In all the instars the newly moulted nymph is white to the naked eye. The eyes are red and the margin of the body appears dark, the black hairs giving to the body its only color, save the median dorsal glands which show through as orange red patches. These possess a pair of openings on their caudal convex margins, the anterior margin being broadly heart-shaped.

The newly moulted nymphs make interesting objects for life activity studies. The pulsation of the dorsal vessel, the silvery branching of the tracheæ, the green malpighian tubules and the outline of the digestive tract are inviting to one with an investigational turn of mind.

Structural Details.—As in previous instars, the pegs in the scooping surface are a little longer, but as yet all are alike. There

is no hint of the sexual dimorphism soon to be seen when the adults arrive.

STRUCTURAL CHANGES IN DEVELOPMENT.

In common with all the other water-bugs with which the writer is familiar, the adults differ from the nymphs in the possession of a larger number of tarsal segments.

In this corixid it is interesting to note that the foreleg of the nymph possesses one less than the requisite number of leg segments. In the late fifth instar the terminal segment of the nymph may be seen to contain the tibial and tarsal segments of the adult (see fig. 10). The middle leg has the same number of segments in the nymph as in the adult. The tarsus of the hind leg is one-segmented and the two segments of the adult can be seen within, shortly before transformation.

All the nymphs have two distinct claws on the hind tarsi. These are very distinct in the first instar as shown in fig. 6.

The antennæ of the nymphs are two-segmented but four-segmented in the adult. The terminal segment of the late fifth instar nymph incases the three outer segments of the adult (Pl. IX, fig. 15).

THE ADULTS.

A technical description of this species is not attempted. Its limits have not been defined, as yet, by Dr. Abbott, who is working on a monograph of this difficult group. It is to be hoped that the above mentioned monograph will be made available to the general worker at an early date. At present we must content ourselves with indefinite designations.⁷

The species whose life history is here presented is a common one in our ponds and pools in Kansas. It is especially in evidence in the clear small pools which in excessively dry seasons disappear.

This corixid is of medium size and barred with a pattern of yellow and brown. The arrangement of the darker pigment pattern being delineated in fig. 2.⁸

Like other corixids, the males and females are to be distinguished by the somewhat larger size of the female and by the peculiar asymmetry of the abdominal segments of the male, as shown in the sketch

⁷ Dr. Abbott has stated that this species is a member of the alternata series.

⁸ Drawn for me by Miss Edmonson, a Junior in the department of Entomology of University of Kansas.

(fig. 17). There is also a certain sexual dimorphism manifest in the pala, or terminal segment of the foreleg.

LABORATORY STUDIES.

After having discovered the source of their food supply, the glass petries employed in bacteriological work were found admirably suited to the needs of one wishing to study the habits and life history of these boatmen.

In order to obtain definite data on the number and length of the instars, newly hatched corixids were isolated in 11 cm. petrie dishes, and the dates of ecdysis recorded.

In addition, they were reared in petries and also in large porcelain-ware pie-pans, as general checks on the isolated rearings. All of the laboratory observations were accompanied by observations of the general cycle in nature.

Space does not permit the recording of the notes on all the lot rearings, but two are herewith presented to suggest in a general way the variation of development for the spring generation.

Petrie F.—A petrie dish, 15 cm. in diameter, was chosen to carry an entire lot through as a general control on the isolated rearings.

Eggs were laid on a large dead cottonwood leaf in the laboratory between the afternoon of March 25 and the morning of March 27.

On April 8, two were hatched, and the remaining eggs showed the red eye spots of the embryo within. The eggs continued to hatch until April 14. On this day, one entered the second instar. April 20, the first entered the third instar, and by April 24 there were several in this stage. On Friday, April 28, one passed into the fourth instar, and in the next few days, the others followed it. The first entered the fifth instar on May 4, and all had reached this stage by May 6. The first adult, a male, appeared May 10. The last adult came forth May 17. So, for this lot, we see that eggs laid about March 26 gave forth adults from May 10 to May 17, a period covering from about 45 to 53 days, and allowing a variation of about a week in the development of boatmen from a single laying. This is evidence enough that the rearing should be carried out on a much larger scale than is presented in this paper, in order to ascertain the maximum time to be found in each period of development.

Petrie K.—Since this series represents the second lot and was started some two weeks later than those of lot one, a large petrie similar to petrie *F*, was used as general check on the isolation rearings. The eggs were laid on a leaf, during the night of April 11. By April 16 the red eye spots had appeared on several, and at least a dozen had hatched by April 19. The remainder of the eggs showed red eye spots. All had hatched by April 20, and the petrie was swarming with young corixids. Many were removed to make room for the number permitted to remain—still a goodly number. April 25 marked the first one to come forth into the second instar. It was milky white with red eyes, and the large glands beneath the dorsal wall of the abdomen showed plainly. The tracheæ were to be seen as silver threads branching through the body. April 27 records many second instar forms and on May 2, third instar forms began to appear, so that all were in this stage by May 4. On May 7 approximately half of the nymphs were fourth instars, and now measuring in length about the diameter of the field of the binocular being used. (Zeiss, 2x eyepiece, 3 A objective.)

The first fifth instar form came May 13, followed by two more the next day, and all of the rest by May 16. Two adults appeared on May 24, and others followed during the next two days. They were confined here to obtain the time required for coming to maturity, but they died, one by one, till the last one departed June 25, after having lived in the petrie as an adult at least a month. It proved to be a male. For this lot, from eggs laid April 11, adults appeared during the period from May 24 to May 26, allowing 43 to 45 days for their development, a time somewhat shorter than those recorded in petrie *F*.

CONCLUSION.

The notes above presented record the first rearing of the boatmen in close quarters. Rearing may be carried on in petril dishes if given daily attention. In large aquaria, prepared before hand and allowed to reach a natural condition of balance the five or six species with which the writer has had experience may be followed through their life cycles with slight attention.

In nature the majority of the Boatmen spend their time on the bottom of the shallower parts of the ponds and pools. Foraging midst

the flocculent deposits at the bottom of the pool they gather the organic ooze and some of the population both plant and animal that it contains. The living organisms consumed in their feeding range from the filamentous algæ to rotifers and oligochaete worms.

They in turn are preyed upon by many aquatic carnivores and may be looked upon as members of the producing class.

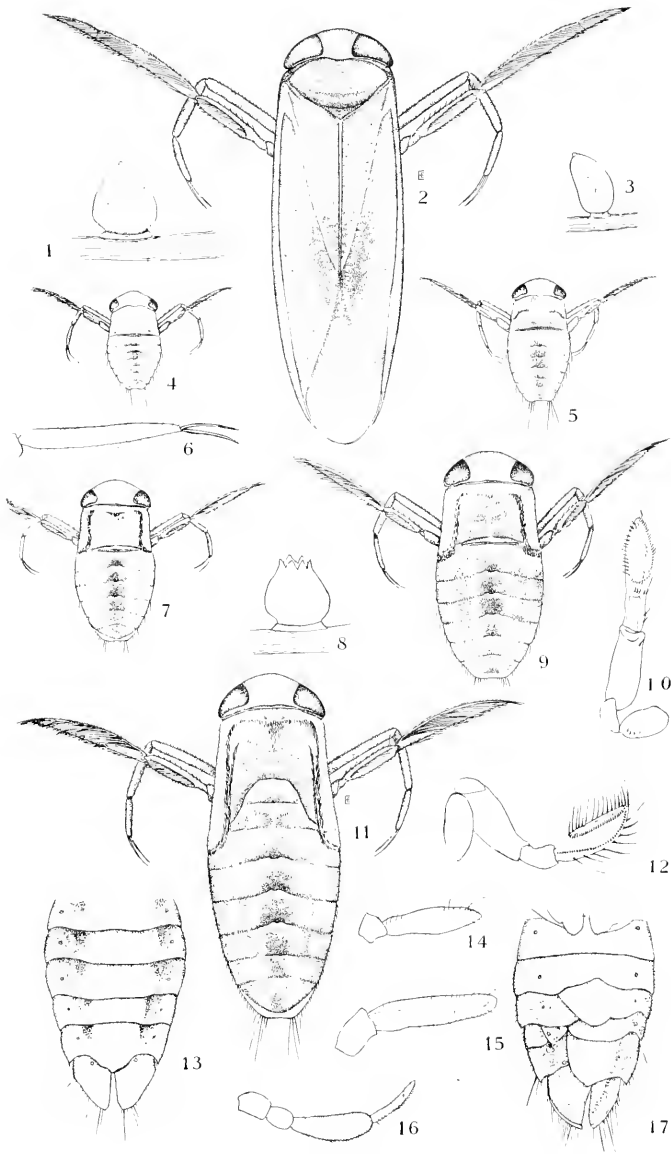
Their eggs appear a little earlier in the spring than those of *Notonecta*. The incubation period of the egg covers a week, and each of the five nymphal instars requires approximately a like time,⁹ thus bringing them to the adult stage in some six weeks. While they may be found many times in all stages of development, the definite broods are not difficult to follow in nature, and in proper waters, with an absence of a dominating predatory population, they thrive in astonishing numbers.

Of all the true water bugs, they alone have been found the forage of any of the fishes. May they in some small measure at least ameliorate the unfortunate reputation of the rest of the water bugs, whose predatory and cannibalistic tendencies have been many times recorded.

EXPLANATION OF PLATE IX.

- Fig. 1. Egg of the corixid species here considered.
- Fig. 2. Adult corixid, *Artocorixa alternata*?
- Fig. 3. Egg of a smaller undetermined species.
- Fig. 4. First instar nymph.
- Fig. 5. Second instar nymph.
- Fig. 6. Tarsus and claws of hind leg of first instar.
- Fig. 7. Third instar. Note the fringe of black hairs on the wing pads.
- Fig. 8. Egg shell after hatching, showing the characteristic rupturing of the egg for the egress of the nymph.
- Fig. 9. Fourth instar nymph.
- Fig. 10. Front leg of late fifth instar nymph showing the tibia and tarsus of the adult within the terminal nymphal segment.
- Fig. 11. Fifth instar nymph.
- Fig. 12. The foreleg of the adult male.
- Fig. 13. Ventral view of abdomen of female.
- Fig. 14. Antenna of third instar nymph.
- Fig. 15. Antenna of late fifth instar, showing the three distal segments of the adult in the terminal nymphal segment.
- Fig. 16. Antenna of adult.
- Fig. 17. Ventral view of abdomen of male, showing the peculiar asymmetry of the segments.

⁹ The last nymphal instar often requires a longer time.



Corixa

NOTES AND DESCRIPTIONS OF GEOMETRIDÆ.

By W. S. WRIGHT,

SAN DIEGO, CALIFORNIA.

Platæa californiaria pasadenaria new subspecies.

Expanse 34 mm.

Palpi, head, antennæ and thorax as in *P. californiaria* H.-S. Color less deep, being a much browner brown. Lines the same except that the angles are much sharper and deeper; the course of the first line from costa to submedian is wavy rather than indented or toothed as is often the case in *californiaria*. The color is much more evenly laid, the wing surface having a much less speckled appearance. Beneath, the primaries are strongly irrorated along the costa but smooth on the disk or with very faint irrorations, the lines showing through faintly. The secondaries are white, much irrorated, with a strong extra-discal brown line angled on the fold and on vein 2, a submarginal line parallel to the first, both having a whitish shade on the outer side much the same as in *californiaria*, but the angles sharper and the line more evident than in most specimens of the former species. Discal dots rather prominent.

Holotype male, Pasadena, Cal., May 1, 1902.

Allotype female, Pasadena, Cal., April 10, 1902.

Paratypes, 5 males, 4 females, Pasadena, Cal., April and May. In American Museum of Natural History and author's collections.

The differences between *californiaria* and *pasadenaria* are most noticeable when series of the two are placed side by side; they then become quite as prominent as the differences between *californiaria* and *lessaria* Pearsall. What particular conditions about Pasadena that would favor the evolution of a local race of this insect are unknown to me, unless it might be that the climatic and floral conditions are more favorable to the fullest larval development there than at San Diego, Cal., from which place practically all the known specimens of *californiaria* come. *Personaria* Hy. Edwards, the type of which is in the American Museum collection, comes from the high Sierras and is much closer to *californiaria* than is this new form.

Pherne subpunctata vernalaria, new form.*Male*.—Expanse 32 mm.

Primaries: Basal area gray, slightly ochreous. First line narrow, ochreous with dark brownish gray shade beyond, sharply angled to subcostal, thence perpendicular to inner margin, with a very slight curve near the end of the line. Mesial band mouse-gray with a tinge of ochreous. Extra-discal line

ochreous preceded by a dark, brownish shade. Terminal space shaded outward to margin, becoming dark mouse-gray with a slight ochreous tinge. Fringe with glistening white tips. There is a more or less distinct dark spot in the fringe at the end of vein six and two more between vein four and the anal angle. The wing has the appearance of being shaded from light ochreous-gray at the base to dark mouse-gray at the margin.

Secondaries concolorous with, but lighter than the primaries, shading from light at the base to dark at the margin without trace of either spot or line.

Beneath the primaries are rather evenly dark smoky with ochreous along the costa and whitish mottling at the apex. Outer line distinct. Secondaries evenly striated with ochreous and brownish-gray. A very faint line shows beyond the disk.

Female.—Expanse 34 mm.

First line of the primaries exceedingly faint, otherwise as in the male. Mesial band concolorous with the basal area. Extra-discal line same as in the male. Terminal space a little darker and more brown than in the male. Secondaries evenly light ochreous-gray with slightly darker margins. Beneath as in the male.

Holotype male, San Diego, Cal., February 12, 1916 (Wright).

Allotype female, San Diego, Cal., March 20, 1912 (Wright).

Paratypes, 18 males, San Diego, Cal., March and April, in American Museum of Natural History collection, 8 males same data, author's collection; 4 females, San Diego, Cal., March to June, Am. Mus. Nat. Hist. coll. and 4 females, San Diego, Cal., March to May, author's collection.

In determining this form I had before me a series of more than a hundred specimens, all from San Diego and vicinity, and taken on dates representing every month from the middle of February to the latter part of August. The range in color shown was from a pale ochreous in the late specimens, to the dark ochreous-gray of the early specimens, the typical color of *subpunctata* being prevalent from the last of May on, through June, July, and August. It was this fact that led me to describe this form and give it a name. In size *vernal-laria* ranges much larger than *subpunctata*, this range corresponding with the range in color. *Subpunctata* also seems to prefer the higher altitudes, being rarely taken in San Diego proper, while *vernal-laria* appears to be confined exclusively to the region close to sea level.

Phengommatæa edwardsata berkleyata new subspecies.

Wing expanse 39 mm.

Antennæ scaled outwardly and tinged with brownish, naked and yellowish inwardly. Palpi cream white, darkened on second and third members with brownish.

Male.—Front creamy white, the scales between the antennæ projecting and slightly overhanging. Collar, thorax and patagiæ yellow tinged with brown. Abdomen slightly darker dorsally at the base, fading to cream white on the sides and tip.

Primaries: Basal third yellow washed with brown. A narrow irregular brown line beginning at the inner third on costa courses sharply outward to middle of cell, thence inward to basal fourth of inner margin. An outer brown line begins on costa before the apex and courses very irregularly across the wing to outer third of inner margin. This line is scalloped inwardly with the points on the veins. A large blunt tooth points outward on vein four; just beyond is a bright yellow shade, rather sharply defined and narrow; the space beyond shade is wood-brown with a faint lilac-tinted patch near anal angle. The broad mesial band is covered with brownish-lilac scales, almost obliterating the yellow ground color except a wide brownish-yellow streak on the costa and a rather large brownish-yellow discal spot in the outer end of the cell, which is circled by a fine dark brown line.

Secondaries: Pale pellow, darkening somewhat outwardly. An indefinite brownish spot at outer third of inner margin indicates a cross line which appears very faintly on the veins in the middle area.

Beneath pale yellow, the outer line on the primaries being slightly indicated near the apex.

Female.—Same as male except that the discal spot is obsolete or but faintly indicated by a few brown scales. The outer fourth of secondaries considerably darkened with fuscous and the cross line much stronger than in the male, being easily traced as far as the middle of the wing.

Holotype male, Berkeley, Cal., March 1, 1915. Larva on White Pine (VanDuzee.) In author's collection.

Allotype female, Berkeley, Cal., April 9, 1915 (Graves). In Denton mount. In Univ. Cal. collection.

Paratype, one male in Strecker collection, Field Museum, Chicago, Ill.

This species is much smaller than *edwardsata*, and while it seems to be only a form of that species it may prove to be a valid species instead of a subspecies as here designated. It is apparently confined to the west coast as the types are from Berkeley, near San Francisco, and the paratype is from Washington (Territory).

I am indebted to Mr. Frank E. Watson, of the Am. Mus. Nat. Hist., New York, and to Mr. Louis Swett, of Boston, for assistance and advice in the preparation of this paper.

AMMODONUS FOSSOR ON STATEN ISLAND.

BY WM. T. DAVIS,

NEW BRIGHTON, STATEN ISLAND, N. Y.

This beetle was described by Dr. Leconte in 1847 in *Fragmenta Entomologica*, Journal Academy Natural Sciences, Philadelphia, 2d Series, 1, p. 92, and the localities given are at Trenton and at Bath, Long Island, in white sand.

Dr. George H. Horn in his Revision of the Tenebrionidæ of America North of Mexico, Trans. Am. Philos. Soc., Vol. XIV, 1871, p. 359, has this to say of *Ammodonus*: "The generic characters are of such a nature as renders any detailed description of the unique species unnecessary. The margin of the body is fringed with short hairs, the surface black, but densely clothed with ash-colored scales. On the elytra the vestiture is less dense, and three series of rounded spots are visible on each elytron, in which the scales are paler and more densely placed. The under surface and legs are paler and the scales sparsely scattered. Length .18-.22 inch. Not common in collections. It has been found in considerable numbers burrowing in the sand in the neighborhood of Trenton, and at Bath, Long Island."

In *The Beetles of Southern Arizona*, Bull. Lab. Nat. History, State University of Iowa, June, 1898, p. 310, *Ammodonus fossor* is recorded from Tucson, "about street lights," by H. F. Wickham. In the New Jersey List (1910) it is reported from "West Bergen, rare (Bischoff)." In the U. S. National Museum Collection are specimens from Goliad, Texas, November 17, and Oracle, Arizona, July 23, and in Mr. Charles W. Leng's collection are examples from Cypress Mills, Texas, 1886 (Schaupp); Tucson, Arizona (Wickham), and Medora, Kansas, May 29, 1899 (W. Knaus). Maryland is given as a locality on a specimen in the collection of the Academy of Nat. Sciences of Philadelphia.

Though the above mentioned specimens are thus recorded in collections and literature, it is probable that the western ones are *Ammodonus granosus* Fall, Canadian Entomologist, January, 1912,

described from three examples collected by Gustave Beyer in the Rincon Mountains, Southern Arizona.

To the localities for the true *fossor* of the Eastern States may now be added Staten Island, N. Y., on the up-beach at Ward's Point, Tottenville. On June 5, 1914, the writer was seated on the sand by the trunk of an ailanthus tree that is destined to be killed by the encroaching sea, when a small turtle-shaped beetle, about five millimeters in length, was seen to move an inch or two in the sand, which it closely resembled in color. If I kept quiet it would move about frequently, but only an inch or two at a time. I soon found that there were others about and that they sometimes buried themselves in the sand; occasionally upon carefully examining a small area, I would see one suddenly appear on the surface from its subterranean wanderings. They were really quite common and a considerable number were soon collected.

On September 18, 1914, Mr. Charles W. Leng visited the locality with me and we looked about on the surface for *Ammodonus*. There were none, but by digging four or five inches below the surface, among the roots of the large crab grass, *Syntherisma sanguinale* L., we collected a number, though of course they could not be found as commonly by this method as in early summer when they came to the surface in the sun. On May 14, 1915, several were found about a quarter of a mile to the eastward along the beach, and on July 9 and 10, 1915, the original locality was visited by Mr. Ernest Shoemaker, Mr. Lewis B. Woodruff and the writer, when the beetles were again collected in considerable numbers. Four pairs were found in copulation, and the male was observed to be smaller and narrower than the female; also the males seemed to be generally darker, that is to have some of the scales worn off of their elytra.

SYNCALYPTA SPINOSA IN NORTH AMERICA.

BY CHARLES W. LENG,

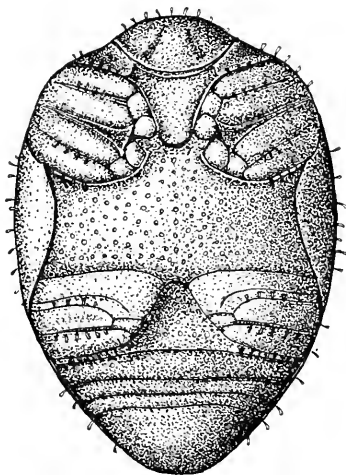
WEST NEW BRIGHTON, N. Y.

It is said in Col. T. L. Casey's paper on the Byrrhidae (Mem. III, 1912) that the genus *Syncalypta s. str.* does not occur in America. This statement now appears to require modification, for while collecting near Batavia, N. Y., in June, 1916, under the guidance of Mr. Harry H. Knight, and in company with Mr. Wm. T. Davis and Prof. J. Chester Bradley, I found beetles of this genus in abundance. The locality was a lane through the Chapin farm, which had been flooded shortly before our visit, and I was examining piles of rubbish left by the receding waters when I noticed a minute, convex, oval beetle, beset with clavate hairs, crawling on the soil between roadside weeds. Continued search by all members of the party showed that it was not uncommon locally and about fifty specimens were obtained.

The determination of the species has not however proven an easy task; the resemblance to *Syncalypta spinosa* Rossi, common in middle and southern Europe according to Ganglbauer (Käfer von Mittel Europa, IV, 1, p. 86) is so strong that I am inclined to believe our find was an introduced colony, particularly as the western part of New York abounds in colonies of introduced epigæal Rhynchophora, such as *Phyllobius impressifrons* at Batavia and *Barypcithes pellucidus* at Portage. However, Casey mentions the possession of but three specimens of *Curimopsis*, a subgenus of *Syncalypta*, as an example of the rarity of these insects in our collections and it may be that from its rarity, the American species of *Syncalypta s. str.* has heretofore been overlooked.

I have consulted with Mr. Chas. Schaeffer and with Mr. E. A. Schwarz on this point and from the latter I learned of an additional locality for *Syncalypta*, viz.: Suffield, Conn., 1913, the specimen being in the U. S. National Museum, where also additional material in *Curimopsis* may be found. The final decision as to the status of the Batavia specimens must be made in conjunction with the study of these allied forms; but in the meantime it is evident that the genus occurs in America.

Syncalypta is an interesting beetle on account of its contractile powers, for not only can the legs be folded up and tucked away into recesses provided for them, but the head can be folded beneath the



Underside of *Syncalypta*, fully contracted, drawn by Chris E. Olsen.

thorax, so that eyes, antennæ, and mouth parts disappear entirely. The adjoining sketch by Mr. Chris. E. Olsen will give a better idea of its appearance than a lengthy description. The European species is said to live in sandy shores by bodies of water.

ON SOME NORTH AMERICAN CLERIDÆ (COL.).

BY CHARLES SCHAEFFER,

BROOKLYN, N. Y.

Cymatodera antennata Schaeffer.

C. antennata Schaeff. Journ. N. Y. Ent. Soc. XVI, 128 (1908).

C. soror Wolc. Field Mus. Nat. Hist. Publ. 144. Zool. Series VII, 342.

The unique specimen from which Wolcott described his *soror* is undoubtedly a male and not a female as it agrees in every respect with my *antennata*. The female has the second and third antennal

joints relatively longer than in the male, that is, both joints are about as long as the fourth joint and the last ventral segment is broadly rounded at apex. Besides the type locality I have specimens from Nogales, Prescott, Phoenix and several specimens from the old Merkel collection simply labelled "Ariz."

Cymatodera fascifera Leconte.

The figure of the last two abdominal segments of this species given by Dr. Horn are those of the female. The male has the fifth and sixth ventral segments arcuately emarginate at apex, the sixth more deeply than the fifth. The last dorsal segment in the single male before me has the apical margin somewhat irregularly bisinuate at tip.

Cymatodera brevicollis new species.

Form and color like *ovipennis*. Head densely and somewhat coarsely punctate; antennæ reaching a little beyond the basal angles of elytra, third joint a little longer than second and equal to the fourth. Prothorax distinctly shorter than in *ovipennis* but similarly constricted in front and behind middle; surface rather closely and somewhat confluent punctured, antescutellar impression distinct. Elytra slightly wider at base than the basal margin of prothorax, gradually widening to about apical third, thence more rapidly narrowing to apex, the tips more narrowly rounded than in *ovipennis*; the series of punctures distinct to about middle, from here to apex obliterated, surface somewhat finely rugose; a little above middle a rather irregular, transverse, yellowish spot, which does not attain side margin nor suture; surface sparsely clothed with shorter yellowish and intermixed with a few longer hairs. Ventral segments sparsely punctate, segments three and four transversely strigose; clothed sparsely with short yellowish hair; fifth ventral broadly and rather feebly emarginate, last ventral rounded at tip. Length 9 mm.

Arizona.

The single specimen, a female, was placed in the Dietz collection with *ovipennis*, which it superficially very much resembles. It differs, however, from that species in having slightly longer antennal joints, a shorter prothorax, the apices of elytra much more narrowed and having well developed wings, which latter are absent in *ovipennis* and allies.

Clerus viduus Klug.

Clerus viduus Klug, Abhandl. Berl. Akad., 1842, p. 297.

Clerus jouteli Leng, Journ. N. Y. Ent. Soc., Vol. XVII, p. 103.

Clerus jouteli Leng was named after our mutual friend Louis H. Joutel and I regret very much to be compelled to relegate it to synonymy.

Clerus viduus was described from North America and was listed in Crotch's list but omitted in the Henshaw list. The species seems to be very rare and besides the type of *jouteli*, which was collected by Mr. Leng in Georgia, I have seen a specimen in Col. Robinson's collection taken by him in Virginia. The species has received three additional names from Spinola, Chevrolat and Gorham.

***Clerus rosmarus* var. *virginiensis* new variety.**

Form, size and coloration as in *rosmarus*, except that the entire elytra is reddish, the lunate transverse fascia is bordered on each side with black, the upper and lower black border uniting at suture; the subapical black fascia of typical *rosmarus* indicated in var. *rufulus* by darker reddish color than the red apex and clothed sparsely with short black hairs, apex clothed with sparse white hairs. Abdomen red, femora piceous, except the front femora which are reddish, tibiæ and tarsi black. Length 6.5 mm.

Virginia.

I have seen a number of specimens of *rosmarus* from different localities but not one that would seem to be intermediate between typical *rosmarus* and var. *rufulus*. In *Clerus lunatus* similarly colored specimens occur with only a narrow black border limiting the lunate fascia which, however, are connected by intermediate specimens with a form from Texas which has the elytra entirely black from a little above the lunate fascia to apex.

***Clerus thoracicus* var. *subcostatus* new variety.**

Form, size and coloration as in *C. thoracicus* but elytra dark blue, rather more coarsely sculptured and alternate intervals with more or less irregularly elevated longitudinal lines and clothed with short, dark hairs. Length 6 mm.

Enterprise, Florida (O. Dietz).

I have another specimen from New Braunfels, Tex., which agrees with the Florida specimen in the characters given above.

In typical *Clerus thoracicus* the elytra may be black or dark blue but is less coarsely sculptured than in the form described above and without the irregularly interrupted longitudinal costæ, the pubescence of elytra when viewing the specimens from the front

looks distinctly grayish-white, while the pubescence of *subcostatus* appears to be dark brownish.

It is possible that this form is the true *cyanipennis* of Klug, which is recently placed as a synonym of *thoracicus*.

Aulicus femoralis new species.

Head, first three joints of antennæ, prothorax at sides, an elongate humeral spot, an oblique submedian spot, side margins from the humeral to the submedian spot, underside, except fifth ventral segment which is black, and femora at basal half more or less red; disk of prothorax black; elytra blue except the spots indicated above. Head rather coarsely and subrugosely punctate, the punctures sparser at middle. Prothorax slightly wider than long, basally strongly constricted and less strongly near apex; surface moderately coarsely and rather evenly punctate. Elytra not quite three times as long as the prothorax, sides nearly parallel to about basal fifth, thence gradually widening towards middle, from here to apex arcuately narrowing to apex, apices separately rounded; surface rather coarsely and confluent punctate, the punctures finer in the pale markings; vestitures as well as that of prothorax moderately long and whitish. Ventral segments rather sparsely punctate; fifth segment broadly subtriangularly emarginate; sixth segment broadly rounded and with a very deep median impression. Legs clothed with moderately long hairs. Length 6 mm.

Nogales, Arizona (F. W. Nunnenmacher).

By its coloration this species is related to *monticola* but is smaller and a little more robust with prothoracic punctures more numerous and the submedian fascia at middle rather obliquely bent down towards apex. It is perhaps a color variation of *A. nero* which I do not know, the different descriptions of that species describe the head, prothorax and legs black or bluish black.

Hydnocera fuchsi Schaeffer.

Hydnocera fuchsi Schaeff., Journ. N. Y. Ent. Soc., Vol. XVI, p. 132.

Hydnocera nunnenmacheri Schaeff., l. c., p. 133.

Although the type of *nunnenmacheri* is a much smaller and relatively narrower insect I am convinced that it is the same as *fuchsi*. Besides being smaller and of narrower form there is nothing to separate the two.

Cregya peninsularis new species.

Form, size and coloration of *leucophaea* (*vetusta*) from which it differs in having a slightly shorter prothorax with the surface at sides less irregular but with the median and two oblique basal impressions very distinct and deep.

The elytra are gradually widening towards apex, the surface is scarcely depressed: the punctuation is similar to *leucophæa* and the basal area is similarly colored but the median fascia is yellowish-white with a few black dots on disk and sides: the subapical fascia is very pale luteus, bordered above and below by a narrow undulated, black fascia, the apex is yellowish-white like the median fascia. Length 11 mm.

Santa Rosa, Lower California (G. Beyer).

This distinct species is at once separated from *leucophæa* and *granulosa* by the two narrow, strongly undulated black fasciæ, bordering the pale luteous subapical fascia and the yellowish white apex of elytra.

Chariessa floridana new species.

Head, antennæ, palpi, underside and legs black; prothorax orange yellow with a subarcuate, longitudinal, black line on each side of middle, extending from apex to base; elytra dark blue, suture narrowly brownish and epipleuræ orange yellow. Head coarsely, densely and subconfluently punctate; hairs black, at middle more or less orange. Prothorax as long as wide in its widest part; sides from a little below middle rather feebly narrowing to apex but more rapidly towards basal angles which are broadly rounded; surface with very dense, moderately large punctures, vestiture golden yellow but black on the two black submedian lines. Elytra about two and one half times as long as the prothorax; sides slightly widening to about apical third and then arcuately narrowing to apex, apices rather conjointly rounded; surface very coarsely and closely punctate, punctures gradually smaller and denser towards apex; vestiture rather short and black, brown on suture and golden yellow on pale epipleuræ. Legs clothed with moderately long and shorter black and pale hairs. Length 10 mm.

Key Largo, Florida.

The type specimen, a female, was collected and given me by Mr. G. Beyer. It differs from *pilosa* var. *onusta* in having the sides of prothorax more rounded, the first two joints of antennal club shorter and at apex relatively wider, the suture rather indistinctly paler, the prothorax and pubescence of the latter orange yellow and the two black longitudinal lines narrower.

***Ababa* Casey.**

Ababa Casey, Ann. N. Y. Acad. Sciences, IX, 653 (1897).

?*Prionodera* Wolcott, Field Mus. Nat. Hist. Zoöl., VII, 396 (1910).

The above synonymy is given with some doubt. *Ababa crinita* was placed by its describer in the family Othniidæ on account of its

heteromerous tarsi. On my last visit to Washington Col. Casey kindly showed me the type in which I recognized a Clerid and possibly the same as *Thaenroclerus tantillus* which species it seemed to resemble very closely. Unfortunately that species was not represented in Col. Casey's collection though no comparison could be made. However, the next day Mr. Schwarz showed me specimens of that species in the Nat. Museum and judging by memory I did not see any reason to change my opinion expressed the day before to Col. Casey, except that his specimen was perhaps a little more finely punctured than those in the National Museum collection. As I do not possess a specimen of *tantillus* nor *crinita* I am not able to state definitely that it is that species. Wolcott, erecting the genus *Prionodera* for *T. tantillus* describes the tarsi as four-jointed while Casey states that they are heteromerous in *Ababa crinita*. The first joint of the front and middle tarsi are often very small and more or less covered by the second joint and therefore easily overlooked, especially when the joints are densely pubescent.

MISCELLANEOUS NOTES.

Records of *Cœnomyia ferruginea* in the Vicinity of New York City.

—This widely distributed fly is not recorded in the last list of New Jersey insects, so the following records may be of interest. West Point, N. Y., June 3 and 4, 1911, 10 males, 9 females; June 13, 1914, one male. Fort Montgomery, N. Y., May 31, 1903, female. Ramapo, N. Y., May 31, female; June 3, 1905, female. Greenwood Lake, N. J., June 6, 1909, male. Alpine, N. J., May 3, 1909, female. The above mentioned are in the author's collection. In the American Museum there are three specimens from the following localities: Suffern, N. Y., male. Pearl River, N. Y., May 31, 1913, female (F. E. Watson). Hewitt, N. J., June 8, 1913, male.

It will be noted that all of these localities are in the hill country. So far the insect has not been collected in the more level portions along the coast, such as Long Island, Staten Island and the plains of New Jersey. A box containing these flies has a peculiar and not unpleasant odor, resembling that of the bark or dried leaves of the slippery elm.—WM. T. DAVIS.

Some Records of Bees.—Some time ago I received a number of bees from the Queensland Museum, without any information as to collectors. Dr. J. Bequaert, to whom I mentioned the matter, at once recognized from the localities the source of the collection. It was sent out by E. Le Moulton of Paris, who is at present advertising insects for sale in American entomological journals. Dr. Bequaert showed me a series of similar insects, from the same source, in his possession. As many collectors doubtless possess materials from Le Moulton, and as the locality records are new, it may be worth while to record the following. We are still without information as to the actual collectors.

1. Guyand, Maroni. *Acanthopus splendidus* Fabr., *Aglæ cærulea* Lep., *Exærete frontalis* Guér., *Oxæa festiva* Smith, *Bombus incarum* Franklin, *Centris obsoleta* Lep., *C. americana* Klug, *Epicharis conica* Smith, *E. schrottkyi* Friese, *E. affinis* Smith, *Ceratina lata* Spinola, *Eulæma dimidata* L., *E. fasciata* Lep., *E. Mocsaryi* Friese, *E. smaragdina mexicana* Mocs., *Euglossa piliventris* Guér.

2. Tunis. *Melecta luctuosa meridionalis* Gribodo, *Osmia ferruginca* Latr.

3. Ras-el-ma, Algeria. *Andrena albopunctata* Rossi, *Anthidium siculum* Spinola, *A. manicatum barbarum* Lep.

4. Dimbroko, French W. Africa. *Crocisa cæcisa* Friese.

5. N. Djole, Gabon. *Megachile tricolor* Friese.

For other species see Ent. News, 1916, p. 461, and Can. Ent., 1916, p. 406.—T. D. A. COCKERELL.

PROCEEDINGS OF THE NEW YORK ENTOMOLOGICAL SOCIETY.

MEETING OF FEBRUARY 6.

A regular meeting of the New York Entomological Society was held at 8:15 P. M., February 6, 1917, in the American Museum of Natural History. In the absence of the President, Mr. George W. J. Angell acted as chairman, with 21 members and one visitor present.

Prof. Edwin E. Calder, 4 Market Sq., Providence, R. I., was elected an active member.

Mr. Bird read a paper, "A New *Papaipema* from the Prairies," illustrated

by numerous specimens of adult, larva, pupa and drawings of genitalia, giving the story of his finding the larvæ boring in the root of a plant locally called rattlesnake weed. The species is to be called *Papaipema eryngii*.

Mr. Dow read a paper, "The Plague of the Lice and the Plague of the Flies," in which the passages of the Scriptures dealing therewith were carefully considered and compared with the various commentaries.

Mr. Nicolay exhibited his collection of the genus *Buprestis* and spoke of the differences and geographical distribution of the species *striata* and *impedita*.

Mr. Davis exhibited part of his *Cicada* collection, showing the new species, *Okanagana aurantiaca* and *Clidophleps astigma*, and some allied species, explaining the differences between them. He also read a card from E. B. Williamson.

Mr. Clark spoke of the irregularity of the seasons by which, for instance, *Catocala tristis* became less rare this year, while *C. cara*, usually common, was seldom found; and of the excellent results in catching Lepidoptera, Coleoptera and Diptera with his trap lantern, consisting of a 100-watt lamp kept burning all night, with two openings into the room, one 3 ft. \times 4½ ft. the other smaller.

A general discussion followed in which Mr. Davis told of having caught *Catocala tristis* at Yaphank, Mr. Bird described the sugar trap he has used with success and various receipts for making sugar mixture were given by Messrs. Clark, Dow, Davis and Richardson, all agreeing that good molasses, not corn syrup, was necessary and a small quantity of fusel oil, ethyl alcohol, amyl acetate or asafœtida, beneficial. Mr. Richardson gave some data from his experiments in attracting house flies, indicating that about 4 per cent, ethyl alcohol was very good, but 10 per cent. a decided repellant. A discussion of baited jars as traps for beetles followed by which it appeared that the same sugar mixture worked well, though disappointing at times, and that other substances, condensed milk, fish, etc., had also been used successfully; Mr. Davis pointed out that molasses had the advantage of preserving the specimens to some extent.

Mr. Dow closed the discussion with an account of the experiences he and Mr. Engelhardt had at Claremont, N. H., under new arc lights, particularly in connection with a toad that lived under a nearby stoop by day and came nightly to feast upon the insects. He averred that this toad became tame enough to eat out of his hand, and would accomplish the eating of a *Polyphemus* moth by holding it with one foot while he folded the wings with the other to reduce its spread.

MEETING OF FEBRUARY 20.

A regular meeting of the New York Entomological Society was held at 8:15 P. M., February 20, 1917, in the American Museum of Natural History, President Harry G. Barber in the chair, with 22 members present.

Miss Louise Joutel was elected an active member on nomination by Mr. Davis, the by-laws being suspended to permit of immediate action.

A picture of Mrs. Heidemann was presented by Mr. Weiss and a photograph of her late husband, Otto Heidemann, was shown by Mr. Davis.

The death of Bertil Robert Poppius on November 27 last was noted by the President. He was a Finnish author who had contributed largely to knowledge of Hemiptera and Arctic Carabidæ.

A letter from our member, S. G. Rich, now in South Africa, was shown by Mr. Davis.

Mr. Harris read a paper on "Some White Mountain *Cicindela*" and exhibited his collection of *C. ancocisconensis*; in connection therewith he showed a facsimile of the "Family Visitor" in which appeared the original description and discussed the names *dowiana*, *eriensis* and *carolina* proposed by Casey for the forms occurring at other than the type locality, showing that in his long series, the characters assigned to the first two were not constant. He gave also the origin of the specific name, derived from Capt. John Smith's early name for the White Mts., and several facts indicating that the burrows of some species of *Cicindela* are in situations inundated at certain seasons.

The paper was discussed by several members. Mr. Davis spoke of the series of *C. carolina* collected by Messrs. Brimley and Frank Sherman as indicating no greater differentiation than that exhibited by series of *eriensis* and *dowiana*; and of his finding *C. marginipennis* on islands in the Delaware River at Callicoon, where the river overflowed the locality in spring.

The President questioned the validity of the publication of the description of *C. ancocisconensis* in the newspaper "Family Visitor," stating that Van Duzee in cataloging Hemiptera rejected newspaper publications as invalid. (See section 13, page 6, The Entomological Code, by Banks & Caudell.) This question was discussed by several members, Mr. Sherman pointing out that the strict application of the rule would invalidate many early published names.

Mr. Sherman exhibited a photograph made for him by the Chicago Library, of Wm. Couper's list of Coleoptera found in the Province of Quebec, published in the rare "Canadian Sportsman and Naturalist"; also an early price list of Texan Coleoptera published by Belfrage in the "Psyche" Advertiser. Mr. Mutchler mentioned that the first named was in A. M. N. H. Library.

Mr. Dickerson read a paper "Notes on *Leptobyrsa rhododendri*," which was discussed by Dr. Forbes, Messrs. Barber, Engelhardt and Bird, the latter stating that in his experience the best control was attained by a spray of concentrated tobacco solution mixed with whale-oil soap.

Mr. J. W. Angell brought up the question of the color of *Cicindela 6-guttata* turning blue with age. Mr. Davis said he had found dead specimens under bark that were blue and Mr. Harris said very old cabinet specimens, fifty years old perhaps, might turn.

Mr. Dow gave his experience in mixing poisons with sugar mixtures:
Cyanide by its odor acted as a repellant,
Calomel produced no result,
Amyl acetate increased attraction but failed to kill,
Arsenates produced no result,
Strychnine acted as a repellant,
Sugar of lead was attractive but failed to kill,
Carbon disulphide attracted turkey buzzards and Silphidæ.

In the case of termites a sponge soaked with syrup and calomel proved attractive and deadly.

MEETING OF MARCH 6.

A regular meeting of the New York Entomological Society was held at 8:15 P. M., March 6, 1917, in the American Museum of Natural History, Pres. Harry G. Barber in the chair, with 25 members present.

The Curator announced a meeting of coleopterists on Saturday, March 10, subject Coccinellidæ.

The Editor reported on some of the interesting papers to appear in the next number of the JOURNAL, especially one on food habits of *Corixa*.

Dr. Lutz presented a photograph of the late C. H. Roberts, taken on probably his last collecting trip at Ramsey.

The President called attention to a circular of Index of Literature of Economic Entomology that had been received by Mr. Dickerson.

Mr. Davis read a letter from Dr. Raymond C. Osburn announcing his removal on July 1 to Columbus, Ohio, to become head of the department of zoölogy in the State University.

Mr. Dow read a paper on "The Nine Grasshoppers of Israel," giving passages of Scripture with commentaries on the various translations, and his suggestions based on other ancient literature of the insects probably involved.

His remarks were discussed by Messrs. Davis, Comstock and Dr. Lutz in connection with the work already done in identifying Biblical insects, especially by Huntingdon, from modern collections in the regions involved; and by Dr. Forbes, Mr. Woodruff and others in connection with the changes in water conditions and irrigation and their entomological consequences. Mr. Woodruff recalled a visit to Palestine some years ago during a plague of locusts, when he saw the shores of the Dead Sea piled a foot deep and fifty feet wide with dead locusts, while Mr. Dow described the well at Palmyra, on the caravan route, lined throughout its 300 ft. of depth, with camel bones.

Mr. Leng exhibited the beetles caught by Mr. Davis, Mr. Knight and Professor Bradley in western New York in June, 1916, calling attention to a number of introduced European weevils and several species of Carabidæ, differing, either by reason of the more western locality or on account of the

extensive swamps, from those of the vicinity of New York City. He read a paper in which comparison was made with Dr. Wm. L. Bray's "Development of the Vegetation of New York State," in which he emphasized the necessity of considering several factors other than temperature in grouping the beetle species of the state, among which are certainly the local environment and post-glacial dispersion.

Mr. Davis exhibited a large number of insects of other orders caught on the same trip, and read the following memo.

"On June 22, 1916, the dragon flies of interest taken at Portage were *Tachopteryx thoreyi*, found on an open, sunny road instead of on a tree trunk as usual; *Libellula quadrimaculata*, *Tetragoneuria spinegera*, *Zanthus parvulus* and *Aeshna umbrosa*. This last mentioned species has a long period of appearance, as it has been found on Staten Island as late in the fall as October 21.

"On June 23, on the westerly side of Conesus Lake near Long Point, the dragon fly *Tetragoneuria cynosura* with the variety *simulans* was in great abundance and many were resting on dead bushes and the dead branches of trees that were near the ground. Mr. Harry H. Knight collected 31 individuals by sweeping his net about one of the bushes on which the insects had settled. While we were looking at the dragon flies we heard the songs of numerous seventeen-year cicadas and so went up the hill to the woods. The cicadas were sufficiently numerous to keep up a continuous singing, but later they were silent when the day became cloudy. The species was expected to appear in Central New York in 1916.

"In June, 1915, the butterfly *Phyciodes batesii* was collected at Rock City, in Catteraugus County, N. Y., in considerable numbers and a single female at Portage, N. Y., on the 13th of the month. On June 22, 1916, a male was taken at Portage. It has also been taken at Ithaca, N. Y., so the species is certainly not uncommon in central and western New York."

Mr. Davis exhibited a number of photographs of the localities that had been referred to, including Indian Falls, where he found the "woods of the midday night" as he expressed it.

Mr. Comstock exhibited *Lycana sonorensis*, pinned specimens, pupa and living adult freshly emerged, saying that eastern collectors seldom could see this most beautiful California species of the genus alive.

Professor Wright described the capture of about 140 specimens by Mr. Geo. Field and himself near Pt. Loma, Cal. The butterflies to escape the strong sea breeze fly only 5 or 6 inches from ground among the shrubbery on the lee side of the ridge. The food plant is a species of *Cotoledon* or pencil plant of which the closely appressed leaves look like a green pencil growing out of the ground. The larvæ bore into the pencil and the pupa is found in surrounding rubbish. March is the best month to find them.

Mr. Leng spoke of the similar flight of *Lycana* in Labrador, following closely the contour of the rocky surface.

MEETING OF MARCH 20.

A regular meeting of the New York Entomological Society was held at 8:15 P. M., March 20, 1917, in the American Museum of Natural History, President Harry G. Barber in the chair, with 24 members present.

Mr. Engelhardt under the title of "Collecting at Timber Line, Mr. Hood, Oregon," described his journey in August, 1916, through California and Oregon from Sacramento to Portland, and his ascent of Mt. Hood, illustrating his remarks by maps, photographs and specimens. These were collected partly along the margin of the Columbia River before ascending the mountain, among surroundings similar to those found in Maine and included some *Cychnus* and *Omus*, and partly near Cloud Cap Inn on Mt. Hood, at an elevation of about 4,000 feet, where there is a virgin forest preserved as a government reservation. Carabidæ were very abundant at the timber line, and when the sun shone other insects abounded on the numerous hardy flowers, like squaw weed, paint brush, lilies, hellebore, lupines, golden rod and mountain ash, the latter blooming in August at that elevation. Among the butterflies caught were *Lycena fuliginosa*, *pheres*, *amyntula*, *antiasis*, *Chrysophanus mariposa*, *Melittia rubicunda*, *Vanessa milberti*, *Pyramcis cardui*, *Chionobas iduna* and *Argynnis rhodobe*.

Mr. Engelhardt gave a graphic account of the climb to the summit of the mountain, not without danger from crevasses, and of the exhilarating influence of the bitter cold found on the solid ice at the top upon himself and his companions. He was fortunate in having such alternations of sunshine, clouds and snowstorms as to show the mountain under many conditions; three days were spent on the mountain, affording opportunity of visiting the glaciers and forests as well as the summit.

Leaving Mt. Hood, Mr. Engelhardt went further north, visiting Seattle and San Juan Island in Friday Harbor on Puget Sound, where the University of Washington maintains a biological station. Two days were spent here, mainly devoted to marine work with a motor boat, but some moths were taken at the electric lights and *Argynnis bremmeri* and many Carabidæ by day. The island is heavily wooded and would repay further effort.

Mr. Engelhardt's remarks were discussed by Dr. Forbes, Dr. Bequaert and Messrs. Bird and Schaeffer, the discussion bringing out the record of *Vespa austriaca* on the Pacific Coast mentioned at a previous meeting by Dr. Bequaert.

Mr. Bird under the title "Some Remarks on Parasitism" gave a remarkable account of 1,732 parasites, primary and secondary, from one host, showing in detail the processes of nature by which, in spite of the number of eggs laid by the female and the influence of secondary parasites in restricting the operations of the primary, the balance is maintained, so that ordinarily one pair succeeds another. He aimed to show the possibility of following in certain endophytic species, the actual happenings in the field, of the individual through the whole larval and pupal period, by evidence deduced at the close of the cycle. He detailed in part what befell a thousand individuals

surrounded by more than a score of primary and secondary parasites, scavengers and depredators, as well as attacking mammals, bacterial and fungus diseases. He also showed the value such data would have in economic lines, in deducting to what per cent. a given parasite might be expected to control its host. His remarks were illustrated by specimens of the host and parasites and by blackboard diagrams.

Dr. Bequaert compared his experiences in "Collecting Flies on Three Continents" referring especially to his collections in Belgium, in northern Africa and at Lahaway, Lakehurst, Ramsey, N. J., and Chittenden, Vt. He said that on account of the Diptera being especially northern in distribution, the result showed a smaller number of species for New Jersey than for Belgium as was to be expected; but it also showed the presence in New Jersey of certain southern genera, unknown in Belgium, as well as the absence of some exclusively old world genera. Six boxes of specimens were shown and the illustrations, requiring use of lantern were reserved for next meeting. Dr. Bequaert spoke earnestly of the advantages of the personal contact with nature derived from field collecting in pursuing any studies in natural history.

Mr. Woodruff, after reporting his visit to Mr. Sleight's home in Paterson, where he found him still very ill and emaciated, but sanguine and looking forward to an early removal to Lake Hopatcong, exhibited *Schistocerca peregrina* the biblical "locust" described by Mr. Dow at the last meeting.

Mr. J. W. Angell exhibited some rare Lucanidæ, viz.: *Dorcus brevis* Say, found some years ago by Gustav Beyer near the roots of an old pine at Newport News, Va., in June; *Pseudolucanus placidus* Say, labeled Greenwood Lake, N. J.; *Dorcus parallelopipedus* Linn., two specimens from F. Emille, Longueuil, Canada, apparently confirming the North American record given by Nonfried; *Lucanus elaphus* var. *carlengi* Angell, now known from Texas, Kentucky, Illinois; *Necrophorus grandior* Angell and *mysticollis* Angell, new species recently described in Entomological News; *Diphylostoma nigricollis* Fall, and *Cyclommatus imperator* Boileau, from New Guinea, the largest species of the genus.

Mr. Davis exhibited a living *Neoconocephalus triops* Linn. found by Mr. Comstock in a head of lettuce in which it had undoubtedly traveled from its home in the southern states.

The President announced the death of Dr. R. E. Call.

Dr. Bequaert exhibited a huge volume on Hymenoptera, just published in the Guide to Insects of Connecticut, with two similar European works for comparison, praising highly the Connecticut book.

Mr. Mutchler exhibited for Mr. Bird, *Megarhyssa atrata* Fabricius, in its characteristic pose ovipositing in the larval burrow of *Tremex columba*, of which it is a parasite.

MEETING OF APRIL 3.

A regular meeting of the New York Entomological Society was held at 8:15 P. M., April 3, 1917, in the American Museum of Natural History, President Harry G. Barber in the chair, with 23 members present.

The Curator announced the final meeting of Coleopterists for the season on Saturday, April 7, at 2 P. M., subject Coccinellidæ.

Mr. Olsen showed report in daily press of Mr. E. B. Williamson's return from Columbia, S. A., with an account of his journey.

Dr. Lutz exhibited about 16,000 insects collected in Arizona and with maps and photographs illustrated his account of the journey made by Mr. J. A. G. Rehn and himself in 1916. He said in part that starting from New York, June 24, the first collecting of interest resulted from the train being stalled in a swamp in Texas about 9 P. M., so that many insects were attracted to the lights at the rear. Tucson was reached July 3 and the Santa Catalina Mts. were visited first with excellent results at the Lowell Ranger Station in spite of a temperature of 106°. On July 8 a trip was made to Mt. Lemon and later the ascent to Bear Wallow at 8,200 ft. was completed. The contrast between the temperature and vegetation at these stations was strongly marked, for the cold and the damp at the greater height caused suffering and, when the clouds obscured the sun, permitted of picking *Xylocopa* off the flowers by hand, while the vegetation changed from cactus through oak to pine.

The following approximate elevations for different regions was shown on the blackboard:

Desert slopes with mesquite and opuntia.....	2,200-2,500 ft.
Desert slopes with palo verde and giant cactus...	3,500 ft.
Desert slopes with yucca and agave.....	4,500 ft.

Canons with oak occur at 3,500 feet and beyond that elevation the oaks begin to appear also outside the canons, finally becoming abundant and mixed with trees like our eastern ones, *Piñon*, *Prunus*, *Robinia*, *Rhus*, *Solanum*, etc., at 4,000 to 6,000 feet; pines begin to appear next and become abundant at 6,500 feet; forests of fir occur at 8,500 feet. These figures would, however, vary on the different slopes and are only intended as an approximation.

The night work at the most elevated stations was unsatisfactory, but elsewhere the results of using a tent of cheesecloth about 9 feet long by 6 feet wide and 6 feet high, with a muslin floor provided with shelter strips of cheesecloth, were glorious. Both ends were commonly left open and two lanterns hung within. The outside worked like a sheet and attracted many insects, while others took shelter within or on the floor. Rains were frequent and flowers were abundant in the encinal or oak region from 4,000 to 6,000 feet elevation and particularly at Mud Springs good collections were made.

The object of the trip being largely to compare the encinal regions of isolated mountain ranges in southwest Arizona, a wagon trip, with Frank Cole for guide, was started July 24, on information as to the vegetation obtained from the Desert Laboratory. Sonoita, Black Dike, Prospect, Kitts Peak, Coyote Mts., and other localities in the Baboquivari range were visited in the following three weeks. The results were not equal to expectations owing to the stands of oak and pine being of insufficient extent, the oak associations

being in fact found southwest of Tucson, only where lack of trails make them difficult to reach, so a return to the Santa Catalina range was made for further collecting in Sycamore canon and on Mt. Bigelow. Immense congregations of *Hippodamia* were observed at the extreme top of this mountain, the beetles in masses five or six inches deep. Mr. Rehn having already started alone, the return journey was made by Dr. Lutz via San Francisco and Utah. The cost of the entire trip was somewhat less than \$1,000 and the results, as shown by the boxes of insects of all orders displayed, quite extraordinary in respect of the additions to our list of insects previously known, if at all, from Mexico. In Longhorn beetles the result seemed largely due to the persistent collecting at light; in Cicindelidæ it appeared in specimens of *C. calomicra* Bates; in Elateridæ in *Pyrophorus arizonicus* of which a description by J. A. Hyslop will shortly appear, while such rare species as *Laccophilus lateralis*, *Chrysomela rubiginosa* and *Telegeusis debilis*, identified by Mr. Mutchler, added to the interesting character of the beetles generally.

In the discussion that followed Mr. Wright spoke of the number of Mexican forms found by Mr. Watson among the butterflies Dr. Lutz had collected, and by himself among the moths, while Dr. Forbes and Mr. Davis brought out by their questions that the success was not due to an unusually wet season, it having been normal in that respect. The desert, Dr. Lutz said, was caused by an almost total absence of rain at the critical season, but rain could always be expected in July and August.

Dr. Bequaert exhibited with the lantern a large number of colored views of African collecting scenes, mentioning especially the fuel stations on the Congo River where the boats stop for wood, great numbers of wood boring beetles occurring there in the old logs and branches that accumulate, the clearings in the rain forest, and about pools and brooks, also the savannah country and grass plains of the interior. Pictures were shown of great termite nests and of the Queen cell, of the fungus gardens, army ants, ant-inhabited acacia thorns, weaver ants, *Trigona* bees in bamboo nests, and grasshoppers, the whole giving an extraordinary impression of Dr. Bequaert's familiarity with African collecting. Among the pictures an interesting series showed African dwellings in a descending scale of grandeur from the European frame houses at Boma to simple structures built entirely of leaves in the interior in front of one of which stood Herbert Lang and James Chapin.

Mr. Olsen and Dr. Forbes discussed the matter of the weaver ants and those inhabiting acacia thorns giving somewhat analogous instances.

Mr. Davis exhibited *Canomyia ferruginea* and gave some data that will appear in Miscellaneous Notes.

Mr. J. W. Angell exhibited *Plusiotis adaleide* from Mexico, also a *Sinodendron* labelled "Tex" and a *Pseudolucanus mazama* with but one mandible.

Mr. Leng called attention to an article on "Collecting Lady Birds by the Ton" by E. K. Carnes.

Mr. Wright recalled his experience in finding the grass for many acres

filled with ladybirds at an elevation in California of 3,800 to 4,000 feet, with masses congregated under logs and stones. This was, however, contrary to Dr. Lutz's experience not at the summit of the mountain.

MEETING OF APRIL 17.

A regular meeting of the New York Entomological Society was held at 8:15 P. M., April 17, 1917, in the American Museum of Natural History, President Harry G. Barber in the chair with 27 members and two visitors present. The meeting was preceded by supper in the Mitla Restaurant.

A letter from Dr. L. O. Howard was read and discussed by Dr. Felt, Mr. Weiss, Mr. Dow and others; the Secretary was instructed to reply, pledging the support of the members in the steps advocated by Dr. Howard.

Mr. Davis read a letter from Henry Brown, sending greetings from France.

Mr. Davis then spoke of his experiences in "Collecting Insects along the James River." He was the guest last summer of Col. Wirt Robinson, in the latter's home at Wingina, Nelson Co., Va., where he found a wild country, with few roads but attractive paths through the woods. After giving some illustrations from other classes of the wild character of the country, Mr. Davis read extracts from his notes relating to the insects he had caught, mentioning especially his success in finding *Cicada* by following up big hornets *Sphecius speciosus* and digging out their concealed treasures; Col. Robinson's observation confirmed by himself that it is male *Papilio* and *Limenitis* that congregate at roadside drinking places; with some expressions borrowed from the colored people, as "news fly" for *Milesia virginicensis* suggested by its habit of remaining near one on the wing, but stationary as if it were trying by its buzzing to convey news of some kind. "Junie bug" was another expression, used for *Allorhina nitida*, a very common insect, by both white and colored; and both believed that no geometer larva must be dislodged from your garments while it is "measuring you for a new suit." Col. Robinson's Museum, with its copious illustration of local species was a great attraction, and it was Mr. Davis's good fortune to be able to add to it from his local captures, *Canthon viridis*, *Disonychia discoidea* and *Pana-gæus crucigerus*, the first being found on toad droppings. Mr. Davis also crossed the James River into Buckingham County, where the Hesperian, *Achalaris cellus* was part of the booty and the *Ceuthophilus gracilipes* found in Old Joe's Cave, another part, all reinforced by the beautiful river scenes, shown by photographs, amid which they were captured.

Leaving Col. Robinson's home, Mr. Davis traveled down the river to Richmond, Old Point Comfort, Fort Monroe, Cape Charles and thence home by rail, noting on the way that Providence Forge, Lanexa and Hampton looked like good entomological stations, especially the latter, on account of its trolley communications.

He collected in the flat country at Seven Pines near Richmond and at Fort Monroe, where by permission of the authorities, he got into a section of scrub

growth where he found such southern species as *Cicada reperta* by its song, located it with his glass and shot it with his sling-shot, also *Edessa bifida*, the latter identified by Mr. Barber.

Mr. Davis exhibited a large number of photographs and eight large boxes of insects he had caught on this trip, among which the following were especially noteworthy:

Sphenostethus taslei, found dead along wood road,

Atlanticus davisi,

Danais archippus var. *fumatus* Hulst ♀.

Cicindela rufiventris, the common midsummer species in middle Virginia,

C. abdominalis, *6-guttata* and *unipunctata*.

Libellula pulchella, flying naturally on three wings,

Argynnis diana ♂; occurs earlier in greater numbers,

Cicada (*Tibicen*) *winnemana*, *lyricen*, *sayi*, *engelhardti*, *aulates*,

Cychnus stenostomus, found in toad excrement,

Pterodentia flavipes, found dead and being carried by an ant.

Mr. Dow read a paper on "Insects mentioned in the Old Testament," that had not been covered by his previous papers, including ants, fleas, larvæ, moths, gnats and botflies, stating that in all fifteen different insects were referred to.

Mr. Shoemaker exhibited "Moths from Maine, Catskills and Sullivan Co.," caught either by Mr. Nicolay or himself.

Mr. Notman exhibited a "Collection of Adirondack Buprestidæ" containing a larger number of species, which had been identified, in part, with the aid of Colonel Casey's recent work, finding it essential for the recognition of some closely allied species. He called attention especially to the different habits, *Agrilus* only being found on foliage.

In the discussion of these papers, Mr. Nicolay pointed out that a specimen of *Buprestis sulcicollis* was included in Mr. Notman's catch; Mr. Angell asked more particulars of Lanexa, Va., which Mr. Davis said from its low-lying woods of oak and pine with the river and railroad nearby and its partly cultivated character, looked to be an ideal collecting ground. Mr. Leng also recalled that the late H. B. Bailey, of Newport News, had found it most productive.

Dr. Felt spoke briefly of his pleasure in being with his fellow members again and congratulated them on the Van Duzee Check List. He then called attention to the prospective installation of mobilization camps on a large scale and the need of entomological workers in connection with camp sanitation.

Mr. Leng read a letter of Samuel Henshaw to Mr. Edw. D. Harris, a statement regarding the type of *Omus Xanti* Lec. and gave some facts establishing its type locality "Fort Tejon" as in Tejon Pass in the northern part of Ventura or Santa Barbara Co., about fifty miles northeast of Santa Barbara and ten miles south of 35°.

MEETING OF MAY 1.

A regular meeting of the New York Entomological Society was held at 8:15 P. M., on May 1, 1917, in the American Museum of Natural History, President Harry G. Barber in the chair, with 13 members present.

The Treasurer reported a balance of \$1,519.33 on hand, subject, however, to an unpaid bill for the JOURNAL and to the amount due to him for advances against the cost of the Van Duzee Check List.

In reference to the latter amount, Mr. Davis said it was his desire to give it with some addition to the Society, provided a satisfactory arrangement were made with Farmers Loan and Trust Co. to preserve it as a permanent fund. He pointed out the growth of such permanent funds in the case of a sister Society and said he believed that once started, it would grow by gifts from members in our case. After a general discussion and expressions of appreciation of Mr. Davis's generosity from several members, the matter was held over for next meeting, at which a definite proposal from the Trust Co. could be presented.

Mr. Davis, in the absence of the members of the Outing Committee, reported briefly on the trip to Central Park, L. I., April 29, in which nine members participated and found many insects on willow bloom, though the day was too cold for best results.

Mr. Dow announced a field trip to Beaver Meadow on May 6.

The Secretary read a letter from Dr. L. O. Howard, chief of the U. S. Bureau of Entomology, asking members to report any facts regarding overwintering of insects or other factors likely to influence insect abundance.

Mr. Richardson read a paper on "Pulsatile Vessels in Aphididæ," illustrated by blackboard drawings, in which these vessels, situated in the legs between the femur and tibia, were described as probably connected with circulation. It was shown that their movements were more rapid than those of the dorsal heart and that their action commenced at birth and ceased with death, contrary to some statements in the books concerning analogous cases. The paper was discussed by the President and by Mr. Davis.

Dr. Bequaert exhibited the Museum collection of African wasps and read a paper thereon which will be printed elsewhere in full. After recounting his very friendly meeting with Messrs. Lang and Chapin in the Belgian Congo, and commenting on the extraordinary number of insects of all orders they had collected (60,182 was the exact number supplied by Dr. Lutz) he passed to a discussion of the faunal regions of Africa, illustrated by a map, and then to a comparison of its wasps with other regions, ending with particular details of some of the peculiar genera like *Synagris* and *Belonogaster*.

His remarks were discussed by Messrs. Davis, Richardson, Leng and Dr. Lutz, especially in regard to the faunal character of the Abyssinian Highlands. Dr. Bequaert having personally collected in the African mountains was able to testify to the sharp definition of their faunal zones at different altitudes, but insisted that nowhere was the arctic character of European mountains repeated, but always a flora and fauna peculiar to these African mountains predominated.

Mr. Davis exhibited *Tricrania sanguinipennis* found dead on April 22 at Watchogue, Staten Island, and commented on its distribution and habits; also *Danaïa archippus* found on the sidewalk at St. George, Staten Island, April 25 and flying in Brooklyn April 29, these dates being early for an insect known to migrate in the fall.

He also exhibited *Alypia octomaculata* found on April 28, saying that it was also unusual so early in the year, though common on grape vines in June and July. The subject of its being double brooded was discussed by him and Messrs. Olsen and Watson and, after the meeting closed, reference was made to Dr. Riley's article in Am. Ent., II, 1870, p. 151.

Dr. Bequaert, after recalling his remarks at a previous meeting on the color varieties of *Eumenes*, showed from the specimens of African wasps previously exhibited, analogous variations in the great series of *Synagris cornuta*, as well as equally remarkable variations in the size of the jaw-like horns, which, however, always preserved their characteristic color. He said he was unable to trace any correlation between these variations and climatic or other conditions or to associate them in any way with protective coloration.

THE NEW YORK ENTOMOLOGICAL SOCIETY.

Organized June 29, 1892.—Incorporated June 7, 1893.

The meetings of the Society are held on the first and third Tuesday of each month (except June, July, August and September) at 8 P. M., in the AMERICAN MUSEUM OF NATURAL HISTORY, 77th Street and Eighth Ave.

Annual dues for Active Members, \$3.00.

Members of the Society will please remit their annual dues, payable in January, to the treasurer.

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WILLIAM T. DAVIS.

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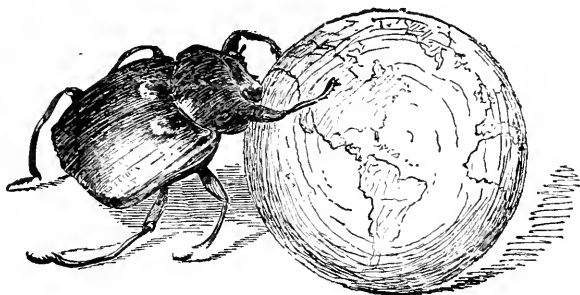
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No. 3.

NOTES ON THE EARLY STAGES OF CHRYSOPS
(DIPTERA, TABANIDÆ).¹

BY WERNER MARCHAND.

PRINCETON, N. J.

Of the 34 species of chrysops known to occur in the state of New Jersey, 11 were found in Princeton; these were the following species:²

1. *Chrysops niger* Macq. Basin, July 4, 5.
2. *Chrysops obsoletus* Wied. Greenhouse near Guyot Hall, July 8, 12; August 26.
3. *Chrysops fallax* O. S. Genetics Garden, July 6, 8.
4. *Chrysops callidus* O. S. Very common. Pond near Guyot Hall; greenhouse; Lake Carnegie; Plainsboro, June; July 4, 6, 8, 14, 15, 20.
5. *Chrysops hinci* Daecke. Near Guyot Hall, July 4.
6. *Chrysops univittatus* Macq. Carnegie Lake; Plainsboro, July 7, 8, 14, 20, 23.
7. *Chrysops lugens* v. *morosus* Wied. Basin; Genetics Garden; June 30; July 8.
8. *Chrysops montanus* O. S. Genetics Garden, July 6, 15.
9. *Chrysops striatus* Wied. Princeton, July 8; August 20, 23.
10. *Chrysops vittatus* Wied. Genetics Garden, July 25.
11. *Chrysops machus* O. S. Princeton, July 4.

¹ From the Department of Animal Pathology of The Rockefeller Institute for Medical Research, Princeton, N. J.

² To these, *Chrysops uter* O. S. has to be added, which is quite common, but was overlooked in 1915, as its time of appearance does not extend July.

All the adult specimens obtained were ♀♀, except the one and only specimen of *C. machus*, which was a ♂. The individuals were collected partly while attacking the collector, partly from windows of the greenhouse, Guyot Hall and the vivarium of Princeton University, partly in the act of egg-laying and on flowers and bushes. One female *C. callidus* was taken in the evening of July 14 on a flower of milkweed (*Asclepias*).

The species were identified with the aid of the collections deposited in the New Brunswick Agricultural Experiment Station and the Academy of Science in Philadelphia. The writer here takes the occasion to thank Dr. Thomas Headlee, of New Brunswick, and Messrs. E. T. Cresson and Dr. Henry Skinner, of Philadelphia, for their help. For material, I am indebted to Dr. Theobald Smith for specimens of *Chrysops* from New Hampshire, and to Mr. Macy, who was in charge of the Guyot Hall greenhouse, and who collected considerable numbers of the flies. Others were collected by boys.

THE EGG-LAYING HABITS OF CHRYSOPS.

Hart (1895) has described the egg-laying habits of *Chrysops marcens* Walker (syn. *astuans* Meigen). Hine (1903) describes the egg-laying habits of *C. callidus* O. S. Part of these observations have been duplicated by the writer, since at the time when the observations were made the literature was not at hand, but as our knowledge in general is still very incomplete, the following notes may add some detail to the results previously recorded.

Observations could be made on *Chrysops callidus* and one other species of *Chrysops*, which could not be fully determined, since only the eggs were found, and no specimen was caught in the act of laying. This species was probably *C. univittatus*. It is of interest that the appearance of the egg-cluster in this species is very different from that in *C. callidus* and the other species observed.

Chrysops callidus is found ovipositing near ponds and streams on semi-aquatic weeds, chiefly in the morning hours till after 11 o'clock, from the latter part of May to the end of July. In oviposition, the females alight on a leaf or reed, head pointing downward, and proceed to lay while moving slowly in a downward direction (Plate X, fig. 1). The eggs are laid in a cohesive mass or cluster, usually on

the under side, seldom on the upper side of leaves, a difference which is not marked in the case of vertically growing plants, such as *Typha*, *Sparganium*, etc. They are usually found at a height of 6 inches to 2 feet above the surface of the water, never on plants which grow any great distance from the water. It seems that in the choice of its laying-place the female is somehow attracted by the sight of the reflecting water-surface.

The plants on which the eggs are found deposited are of a great variety, including *Pontederia cordata*, *Nuphar* spec., *Peltandra* (*Aroidæ*), *Typha latifolia* and *angustifolia*, *Acorus calamus*, various *Gramineæ*, *Polygonaceæ* and *Equisetum* sp. No special preference was shown for any of these, except that where *Typha* was most abundant the eggs were nearly all found on *Typha*; while where *Pontederia* was common there seemed to be more egg-masses on *Pontederia* than on any other plant. Most of the egg-masses seen in the field certainly belonged to *C. callidus*, but it is not impossible that some, while not differing in appearance, may belong to other species of *Chrysops*. The *Chrysops* egg-masses were never found on wood or on stones; the species show a decided preference for laying on plants. The egg-laying instinct is, therefore, apparently determined by two factors: the presence of water and the presence of plants growing above its surface. The egg-masses appear much less numerous in places like Plainsboro, where considerable areas are of a swampy character, evidently because the conditions for oviposition are here evenly distributed. In places, however, where the swamp-vegetation has been artificially removed, as in the case of Lake Carnegie and of the little pond near Guyot Hall (Princeton University grounds), the plant growth is developed only at the edges and it is on these alone that the conditions for oviposition are found. This, perhaps, accounts for the large numbers in which the *Chrysops* are ovipositing here and this phenomenon provides a favorable opportunity for the study of their life-history.

The time of oviposition is, in *Chrysops callidus*, the morning, from 8 to 12 o'clock; and the largest number is found ovipositing between 10 and 11 o'clock. Only very exceptionally I found *C. callidus* ovipositing at 4 o'clock in the afternoon. The habit of laying in the forenoon differentiates it sharply from the other species observed which lay in the late afternoon. The eggs are creamy white at first,

and fresh egg-masses are easily recognized by their color, but in the course of a few hours the color changes first to gray then to shining black, and the majority of the egg-masses found are of this color.

The egg-masses or egg-clusters in *Chrysops callidus* are elongate in shape and much flattened, tapering at both ends, especially so at the upper end; the lower half may be abruptly truncate. Each cluster consists of a single layer of eggs (as Harf has previously stated), which are regularly arranged in oblique rows: their whole arrangement being like that of shingles on a roof, with the difference that the lower eggs overlap the upper ones to about three quarters of their length; hence the arrangement is precisely the opposite of what one should expect if the intention were to prevent rain water from penetrating between the eggs. However, the whole mass, especially when a few days old, presents an almost perfectly even surface, and full protection against moisture is afforded by a thin shining outer layer or membrane, which seems to be a secretion of the eggs themselves covering the whole mass soon after oviposition is completed. It is only after piercing this membrane that individual eggs can be removed from the cluster. (See plate X, fig. 2, which, however, represents an egg-cluster of a somewhat irregular shape.)

The egg-cluster may contain from 250–300 eggs (actual counts gave 277 in one case, 260 in another). The single egg (Plate X, fig. 3), is spindle-shaped, tapering at both ends, but more so at the hind end, by which it is attached to the surface. After oviposition, it is at first semitransparent, and contains, in its upper third, an opaque whitish mass, apparently yolk. This yolk chiefly determines the whitish appearance of the cluster.

The arrangement of the eggs in the cluster is, of course, the result of the special manner in which the eggs are deposited by the female.

In the act of laying, the adult fly sits, as stated, always head downwards on the stem or leaf of the plant selected, and begins, after repeatedly trying out various places, by placing one egg about in the middle of the leaf (*Typha*); it then places a second egg on the side of this, but a little farther down. Evidently the fly first touches the first laid egg with the tip of the abdomen, and then moves the abdomen slightly downwards, by a movement which depends on or is determined by the resistance found in touching the first-laid egg.

The fly then proceeds to lay, beginning from the outer edges of the egg-cluster obliquely downwards towards the lower end. Having reached this, the abdomen finds no resistance to its movements, hence it is withdrawn upwards, and a new series of eggs is laid parallel to the former, or, more frequently, the abdomen is shifted to the other side of the cluster, and here the following row is laid. Sometimes the fly alternates regularly between the right and left side of the cluster, sometimes she may lay two or three rows of eggs on one side, ending near the middle of the cluster at the lower extremity. During oviposition, the female fly is rather quiet, and a leaf or stem may be taken from the field to the laboratory together with the egg-laying fly, as Hine has already stated. After about three quarters of an hour the egg-mass is completed, and the fly darts off suddenly. If disturbed, however, the flies often leave in the middle of the act of oviposition. An egg-mass once abandoned is never completed, as the fly does not return to the same leaf, and evidently has no means for finding her egg-mass again, and no instinct of looking for it. Flies which in a glass jar in the laboratory had continued to lay never started laying again if they once had been disturbed and caused to leave their egg-clusters, but acted like other captive *Chrysops*, which I could never induce to deposit any eggs.

In one case only, a female, having been disturbed in the occupation of laying, and having paused for a few minutes, started again with movements of the abdomen, evidently in the intention to continue laying. However, having changed its position on the leaf but slightly, it could not reach the egg-mass any more with the tip of the abdomen; and after continuing for awhile to press the abdomen against various places on the leaf, as if in search for the egg-mass, it gave up and left. Apparently for each female it takes a long preparation until a suitable place to lay the first egg is found, while to continue the egg-laying act the presence of previously laid eggs is necessary.

Since many females of *Chrysops*, in nature, leave the egg-mass before it is completed, many of the clusters have only their upper half complete, while the lower half ends more or less obliquely truncate or "diamond-shaped" (Hine).

I have described the eggs of *Chrysops callidus* above, and recall that the white coloration of the fresh egg-clusters is due to the pres-

ence of yolk in the upper half of the otherwise semi-transparent egg. However, soon after oviposition is terminated the color of the eggs begins to change and to turn into a mottled grey, thence to shining black. This process can be easily watched under a strong lens. It is seen that the black color appears at first in the upper half of the egg on that side which corresponds to the dorsal side of the embryo and in the shape of a symmetrical spot with several branches reaching backward about to the middle of the egg (Plate X, fig. 6). In this stage the beginnings of the embryonic development may be seen in the lower part of the egg. In about two to three hours, often sooner for in one instance only one hour was required, the entire egg has turned black. In *Chrysops callidus*, therefore, it is not possible to make any direct observations upon embryonic development. The eggs of another species which I found remain transparent and afford an excellent object for such observations.

The duration of embryonic development until hatching, is, in *C. callidus*, about five days. Eggs laid on July 6, 1916, at 11 A. M., were found hatched on July 11, at 12 o'clock, but had probably hatched in the preceding night or early in the morning. Eggs laid on July 20, at 3:30 P. M., were found hatched on July 25, at 11 P. M.

The time of hatching is almost invariably in the evening soon after sunset or later. Times of hatching recorded were 7:10 P. M., 8 P. M., on July 6, 1915; 9 P. M. on July 12; 11:20 P. M. on July 25; 8:30 A. M. on July 13; and between 11 P. M. and 9 A. M. on August 7-8. In one case at least the larvæ were observed to hatch in the morning, at 8:30. Although watched, none were seen hatching during daytime.

The act of hatching itself is not without interest. In most cases all the larvæ hatch at about the same time, each one leaving the egg through its upper pole, and the black surface of the clusters is suddenly seen covered with a whitish wriggling mass. A number of single larvæ may hatch somewhat later and the whole process may take a quarter of an hour. The larvæ are very active and decidedly thigmotactic, clinging to each other and forming masses or lumps, which soon loose their hold on the smooth surface of the cluster and drop to the ground or, under normal conditions, into the water.

It was found that it is absolutely vital for the young larvæ to reach water soon after hatching. Larvæ which were allowed to drop

on a sheet of paper would crawl about for a short while, but an hour later all had died. Efforts to bring them back to life by placing them in water proved fruitless.

Reaching the water under normal conditions, the *Chrysops* larvæ at once sink to the bottom; the lumps are dissolved and each larva moves about with a slow wriggling movement. The young larvæ measure about 1 mm. in length. They are at first positively phototropic, and the majority of them congregate on that side of the jar which is turned towards the light. This tropism is reversed after the first molt and it is evidently then that the larvæ burrow into the mud, where they seem to spend the rest of their life until pupation.

DESCRIPTION OF THE LARVA OF *C. CALLIDUS*.

The young larvæ were placed in small glass jars with a small quantity of mud and aquatic plants. Young crushed dragonfly and Chironomus larvæ were given as food. Their growth, however, was very slow and I did not succeed in keeping them alive much longer than after the first molt. This was partly due to the difficulty of furnishing them a suitable food supply and at the same time keeping the water pure and rich in oxygen, as the pretence of decaying material seems fatal. I will, however, give here a description of the young larvæ, as they have never been described in any species of *Chrysops*. Concerning the larval stages of this genus, we had up to very recently only the description of the full-grown larva of *Chrysops vittatus*, by C. W. Hart (1895). It will be seen that even the very young larvæ of *Chrysops* show very marked peculiarities which permit us to differentiate them from young larvæ of *Tabanus*, at least those which I had under observation.

All Tabanid larvæ are, as we know well, comparatively uniform in structure, hence repetition in description is to some extent inevitable. The young larvæ of *Chrysops callidus* are about 1 mm. in length, elongate, tapering at both ends, with tracheæ not yet filled with air and prolegs not exerted, consequently presenting a more or less even surface. Their color is grayish white (Plate X, fig. 4). The body has twelve segments, the head is small, pointed, blackish brown in color and highly chitinized. The prolegs or parapodia are visible as small knobs on the fourth, fifth, sixth, seventh, eighth, ninth, and

tenth segments, two pairs on each of these segments, forming two pairs of rows, one lateral and one ventral. On the dorsal side of the second segment a pair of black ocelli are visible which in reality lie not on the upper surface of this segment but underneath it on the upper side of the pharynx which, with the head and mouth, is retractile. The eyes are moved forwards and backwards with the pharynx, so as to lie apparently sometimes in the second and sometimes in the third segment of the body. Similarly located at the hind end of the body and situated on the dorsal side of the tenth or eleventh segment lies the "organ of Graber," to be spoken of later, visible as two small black dots. The twelfth segment is terminated obtusely in the newly hatched larva (Plate X, fig. 4).

First Molt.—Only a few hours after hatching the larvæ, placed in water, begin to molt. The act of molting was observed repeatedly and the presence of larval skins in the water indicates that it has taken place. Plate X, fig. 5, shows an individual in the act of molting. This first molt has not been noticed in Tabanid larvæ, nor by Mitzmain, who has given some attention to the subject of molts.

Description of Larva After First Molt.—After the first molt the larvæ are more slender and slightly longer than before. The prolegs are now more in evidence, protruding at right angles from the body-surface, and the crawling movements become much more energetic (Plate X, figs. 7 and 8). In the structure of the head no important changes could be noticed; of these structures and of the mouth parts and antennæ, a more detailed illustration is given (Plate XI, fig. 3). Hart gives as difference between *Chrysops* and *Tabanus* larvæ the relative length of the last and second-to-the-last antennal joints; this character could so far not be verified with certainty in this young stage. A very good character which seems to separate at least those *Chrysops* and *Tabanus* larvæ which I had under observation is found in the tracheation. The main tracheal trunks of the young larva of *C. callidus* are relatively slender and narrow, being between one eighth or one tenth of the abdominal diameter in width, while in the young *Tabanus* larva the tracheal trunks are of much wider diameter. In the *Chrysops* larva, the diameter of the main tracheal trunks remains the same throughout their entire length, while in *Tabanus* they are much more inflated in the posterior half of the body than in the anterior (Plate XI, figs. 1 and 2).

The tracheæ are dark or shining silvery-white, according to the light, and are filled with air. The two main stems converge towards the end of the body, where they terminate in a sharp acuminate tail (fig. 8).

Description Summarized.—Body spindle-shaped, 12-segmented, slightly above 1 mm. in length; general color grayish white, semi-transparent. Head retractile; mouth parts small, dark brownish, chitinized; eyes situated on pharynx, black. Last segment ending in an acuminate tail, on the base of which are two bristles on each side. Segments 4-10 with two pairs of ventral and two pairs of lateral prolegs; the latter armed with short stiff bristles pointing backward (Plate XI, fig. 5). Intestine straight, except in the middle region of the body. Main tracheal trunks parallel in the posterior half of the body, while in the anterior half forming two large semicircular loops, ending in the region of the fourth segment, and here dividing up into small tracheæ. Chitinous surface striated as seen in Plate XI, figs. 4 and 5, Graber's organ consisting of a capsule containing only one pair of black pedunculate bodies.

Movements of the Larva.—These are carried out in the following way: the larva presses the prolegs against the surface on which it moves, then drives the main mass of the body through them by means of contractions in the posterior half of the body, while the intestine is protruded forwards and the head exerted. Then the prolegs abandon their attachment, and seem to be moved forward by the elasticity of the body to which they are attached.

Activities of the Larvæ.—The larvæ were kept in small dishes with water and some aquatic plants. In water without special care they perished in less than a week; when fed and taken care of, they lived slightly longer. As food, crushed dragonfly larvæ, mosquito larvæ, crushed small caterpillars were given and accepted. However, their numbers always rapidly diminished. This is partly accounted for by their cannibalistic tendencies. Mitzmain states that larvæ of *Tabanus striatus*, even if other food was offered, preferred their own kind to any other food given. Another difficulty was to keep the water in small jars free from putrefaction. For this purpose green plants (*Elodea*, *Myriophyllum*) were given, but these plants decayed, and the larvæ perished. Mud seems necessary for the larvæ to burrow into, but renders their observation impossible. With a proper method,

however, it should not be difficult to raise *Chrysops* larvæ, and a new attempt will be made in the coming season.

Chrysops spec.—On July 7, 1916, 6 P. M., a *Chrysops* was seen ovipositing on the under side of a leaf of *Nuphar* (yellow pond-lily), the leaves of which often protrude above the surface of the water, on the north shore of Carnegie Lake, near the Princeton University boat-house. Unfortunately the specimen escaped, but it was undoubtedly a *Chrysops* of rather dark appearance, probably either *C. univittatus*, which is dark and next most common to *C. callidus*, or *C. lugens* v. *morosus*, or possibly *C. niger*. Specimens caught near this place belonged to *C. univittatus*. The egg-mass was collected and was very different in appearance from that of *C. callidus*. On careful search five such egg-masses were found, four on the under side of *Nuphar* leaves, one on the under side of a *pontederia* leaf nearby. As eggs of this kind were found nowhere else, it seems that the species has a predilection not only for *Nuphar* but also for the particular spot where these eggs were found.

The egg-clusters (Plate XII, figs. 1 and 2) differ from those of *Chrysops callidus* and the other species in which the oviposition has been described by the arrangement of the eggs, which are elongate as in the other species but placed with the hind end almost at right angle on the leaf-surface, one close to the other, so as to form a sort of elevated layer, the vertical thickness of which corresponds to the length of the eggs and the even surface of which is formed by the anterior ends of the eggs. The whole cluster is roundish or ovoid in outline, the sides almost right-angled, formed by the rows of eggs placed one beside the other. One of the clusters was found, by actual count, to consist of 352 eggs. The color of the freshly laid one was white, as well as in two of the others when they were found, while in the two remaining it was pale brownish. On the following day the three white egg-clusters had also assumed a brownish color, a proof that they had been freshly deposited when found. It results therefore that this species of *Chrysops* differs from *C. callidus* not only in the way the eggs are deposited and their color, but also in the time of oviposition which in this species is the early evening, before sunset.

Owing to the lack of the dark pigment which obscures the development of the eggs in *C. callidus*, in this species developmental changes may be readily observed.

Each single egg is elongate as usual in *Chrysops*, and slightly curved. It was seen that the concave side of all the eggs was turned in the same direction, that is, towards the edge of the leaf on which the cluster was found. The concave side of the egg corresponds to the ventral side of the embryo. Assuming the fly sits head-downwards while laying, that is, looking towards the base of the leaf and away from its edge, each egg is deposited in such a way that on leaving the body, the ventral surface of each egg is turned backward from the fly. On the other hand, as each egg is fastened to the leaf by its tail end, one should assume that the head-end is the last to leave the body of the fly. In this way the relative orientation of mother animal and embryo could be determined, but the material was insufficient to fully ascertain this relation.

Every single egg is seen to be somewhat shrunken on its upper pole, and its outer membrane is here contracted in three ridges meeting at the tip at about equal angles of 60° .

On the earliest stages of the development of the eggs I have no data, as the eggs were not examined before July 9, at noon, when they were almost two days old. Plate XII, figs. 3, 4, and 5, show the eggs at this stage. The embryo is plainly visible, occupying only about five sixths of the whole length of the egg, leaving the upper one sixth empty. The entoderm is plainly differentiated. A large mass of yolk covers the greater part of the dorsal side. Headwards on the sides are dark areas probably corresponding to the eyes which have however not yet appeared.

On the following day, July 10, at 11 P. M., these eggs were inspected again. The yolk mass had been considerably reduced, still reaching to the posterior end of the egg, and still taking almost two thirds of the entire length. Head and pharynx have become differentiated. The eyes have appeared as two black spots on the dorsal side of the pharynx. The anterior region of the embryo has been pushed forward, and the empty portion of the egg is now less than one tenth of its entire length (Plate XII, fig. 6). When an egg is lesioned at this stage, the yolk flows out immediately as it seems to be quite liquid.

The body segments are not yet distinctly visible.

On the following day, July 11, at 5:30 P. M., the larva is seen to fill the whole space afforded inside the egg-shell. At this stage, that

is, when the embryo is exactly four days old, the final body segments begin to be visible chiefly in the anterior part of the body, and the head and pharynx is seen to be in the retracted condition, while the first body segment reaches to the anterior end of the egg. Pharynx and intestine have become more distinct; the yolk mass has shrunk further, occupying now less than one half of the whole length, and not reaching the end of the body. The tracheæ and the organ of Graber are not yet visible in this individual (Plate XII, fig. 7). However, in a second individual from the same egg-cluster, the organ of Graber is seen already fully developed and also the tracheæ are discernible (Plate XII, fig. 8). The head is seen retracted as in the first-studied individual. Concerning the organ of Graber, it should be noted that if this organ really corresponds to a pair of modified hairs, as assumed by G. Paoli, it should always be simple in the embryo, as it is in fact in *Chrysops*. However, it seems that in the young *Tabanus* conditions are somewhat different. The body segments in the larva (Plate XII, fig. 8) are seen fully marked; the hind end of the body is slightly longer than the space afforded to it, and the last segment is curved in order to find room in the egg. All through these stages we notice a gradual increase in length of the whole embryo in the egg-shell, with the result that even with head retracted within the first segments, and with tail curved backward, it fills the whole available space. This may be of considerable importance in the act of hatching from the egg, as it enables the embryo to burst the egg-shell by simply stretching its body. On Plate XII, figs. 11 and 12, these movements are illustrated.

On the following day, July 12, 4 P. M., the eggs had not yet hatched. However, if the eggs are placed on a slide, a slight pressure of the coverglass is sufficient to cause them to leave the egg with vigorous movements. The young larva (Plate XII, fig. 9) is seen to be a typical *Chrysops* larva, eleven-segmented, with seven pairs of lateral prolegs which are not yet protruded, with two slender tracheal trunks forming loops in the anterior part of the body. The head is retracted and remains so in the larvæ which were caused to hatch prematurely. The yolk mass is still present but takes less than one third of the whole body length. The lower part of the intestine shows irregular windings similar to those seen in *C. callidus*. The organ of Graber is distinctly seen immediately behind the dorsal bloodvessel,

but not connected with it (Plate XII, fig. 10); the space containing the two pedunculate bodies¹ seems to be surrounded by a double capsule.

This egg-cluster perished in consequence of having been placed in too damp conditions, which caused the leaf to which it was attached, to disintegrate. The leaves of *Nuphar* decomposes with great rapidity when detached from the plant.

However, eggs from another cluster of the same species were found hatched on July 9, at 11 A. M. The larvæ were positively phototropic, and much like those of *C. callidus*. They were kept alive for one week in a Petri dish with *Ceratophyllum* and crushed *Agrion* larvæ, but after this period all died.

A third type of egg-cluster was found several times on leaves of *Sagittaria* and *Nuphar*, and of which I can not say whether it belongs to a *Chrysops* or a very small species of *Tabanus*. These egg-clusters are obliquely conical, brown in color; the eggs of which they consist, are elongate as in the other species.² Larvæ which hatched from one of these clusters had more the appearance of *Chrysops* than of *Tabanus*, this (1) because of their small size, (2) because of the tracheæ being narrow as in *Chrysops callidus* and the other species spoken of. They were evidently aquatic but perished within a few days.

EXPLANATION OF FIGURES.

PLATE X.

Fig. 1. Female of *Chrysops callidus* O. S., ovipositing on a leaf of *Typha*. Drawn from life.

Fig. 2. Egg-cluster of *Chrysops callidus*, somewhat abnormally shaped.

Fig. 3. Single egg of the same species. Upper half white (tip translucent), lower half transparent.

Fig. 4. Newly-hatched larva of *Chrysops callidus*. Prolegs still retracted.

¹ It has not been ascertained whether these bodies were pedunculate or not, as the organ of Graber was not known to me then, and no descriptions were at hand. I use here the term "pedunculate bodies" as used by the authors on the subject, for the black bodies readily seen in the capsule which in *Tabanus* have been shown to be "pedunculate."

² I notice in this connection J. S. Hine's statement that the egg-masses of *Chrysops celer* consist of several layers of eggs, being brownish in color. Presumably, then, the egg-masses spoken of belong to *C. celer* or to a related species.

Fig. 5. Young larva of same species, in first molt. Drawn from life.

Fig. 6. Egg of *Chrysops callidus*, a few hours after oviposition, showing pigment developing symmetrically.

Fig. 7. Larva of *Chrysops callidus* after first molt. Ventral side, showing ventral and lateral prolegs.

Fig. 8. Same larva (slightly more extended). Dorsal side, showing tracheal trunks and Graber's organ.

PLATE XI.

Figs. 1 and 2. Young larvæ of *Chrysops callidus* and *Tabanus atratus*, to illustrate the difference in the tracheal system.

Fig. 3. Head and first segment of young larva of *Chrysops callidus*, magnified. Note the long terminal joint of the antennæ. The first joint, which is very short, was not noticed when the drawing was made.

Fig. 4. Posterior end of newly-molted larva. Dorsal view. Graber's organ, *sk.*, shed skin, still adhering.

Fig. 5. Posterior end of newly-molted larva. Ventral view, showing anus, stigmatal spine and bristles.

PLATE XII.

Fig. 1. Egg-mass of *Chrysops* spec. on underside of *Nuphar* leaf (turned upside down). Lateral view.

Fig. 2. Same egg-mass seen from above.

Figs. 3, 4 and 5. Dorsal, lateral and ventral view of two-day-old egg of *Chrysops* spec. Note the empty space above the embryo.

Fig. 6. Egg and embryo of the same species, three days old. The eyes have appeared. The yolk is diminished in quantity.

Fig. 7. Egg with embryo of same species, four days old.

Fig. 8. Egg from same egg-cluster, four days old, but developed a little farther. Body segments and Graber's organ developed.

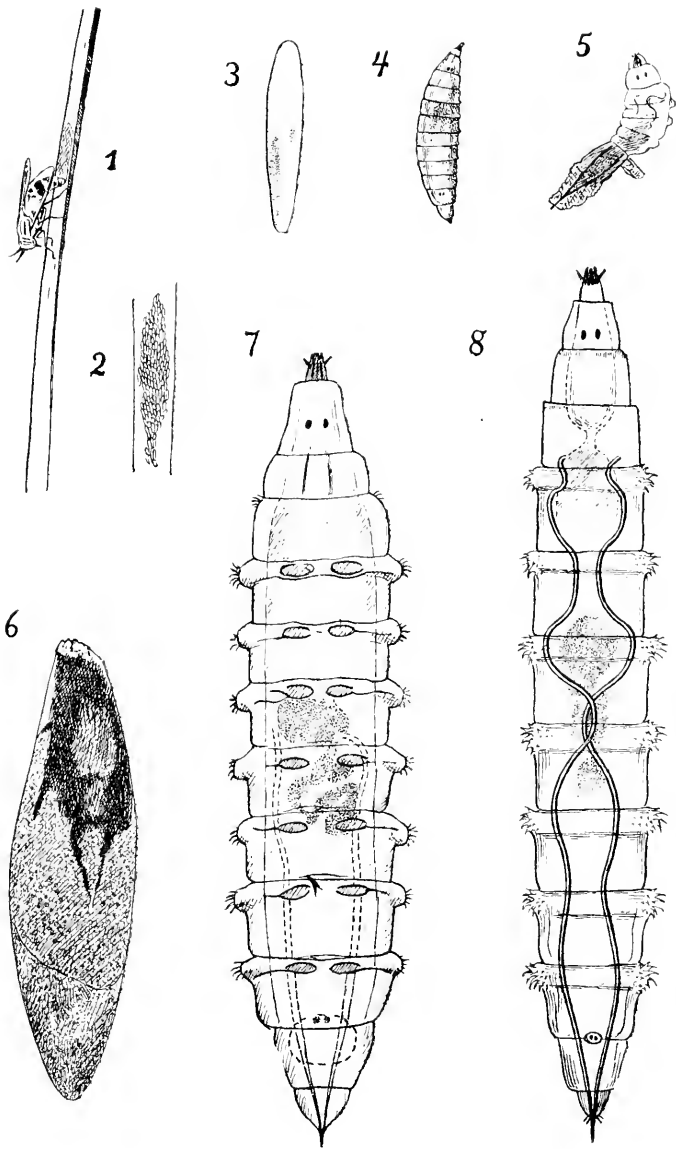
Fig. 9. Newly-hatched larva of *Chrysops* spec. Head retracted and prolegs not yet exserted.

Fig. 10. Graber's organ and posterior part of dorsal vessel of same larva, magnified.

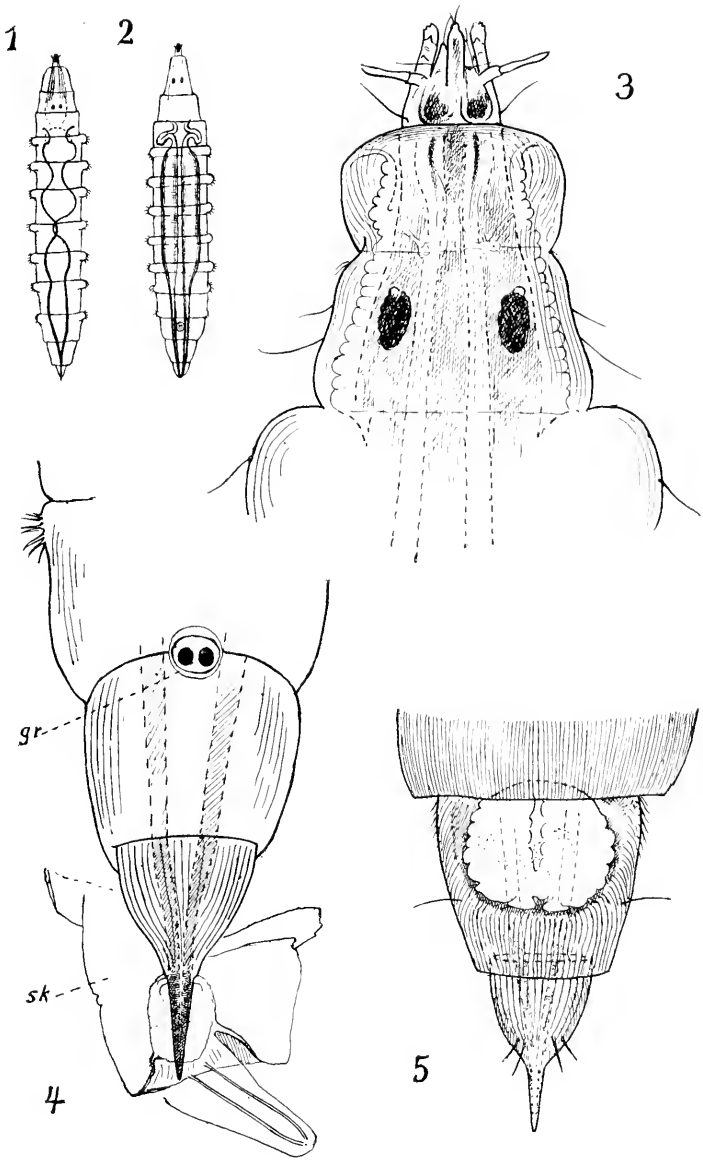
Figs. 11 and 12. Movements of the posterior part of the body of the larva before hatching.

LITERATURE ON EARLY STAGES OF CHRYSOPS.

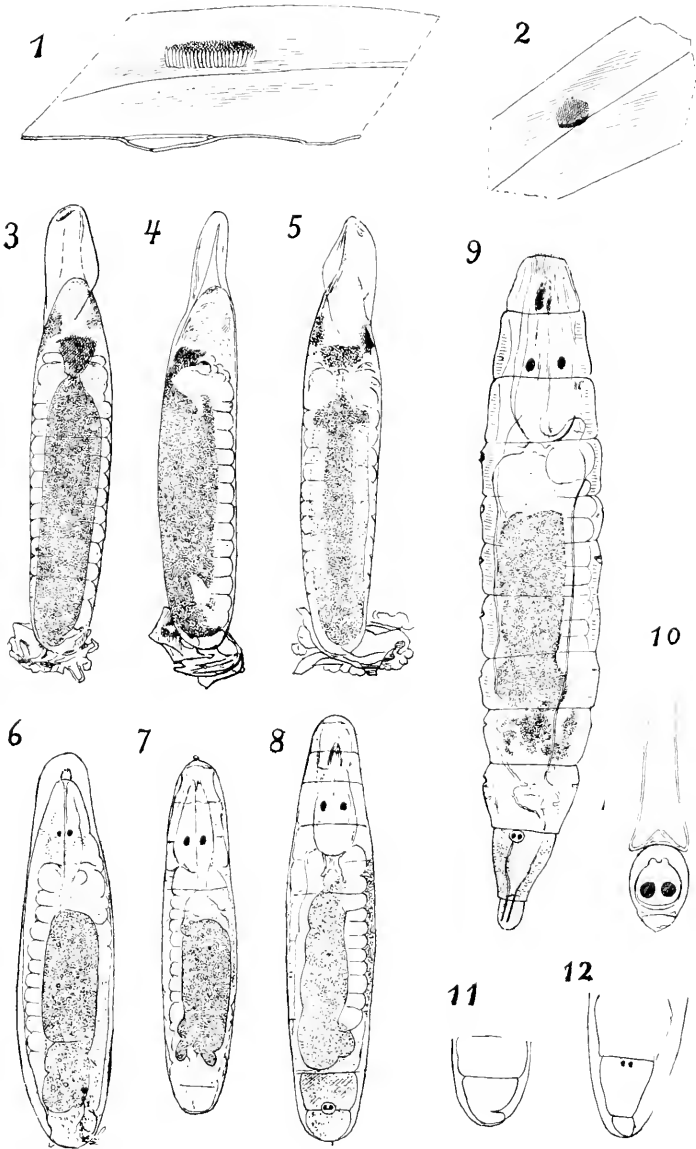
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Chrysops.



Chrysops.



Chrysops.

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NEW DYTISCIDÆ.

BY H. C. FALL.

PASADENA, CAL.

By way of preface, it may be said that the present contribution is the result of a conversation not long since with my long-time friend Mr. John D. Sherman, Jr., at his home in Mt. Vernon, N. Y. Mr. Sherman, as is well known to most coleopterists, has for many years collected and otherwise accumulated North American Dytiscidæ, of which family he doubtless now possesses the largest and richest material to be found in any American collection.

In view of the proposed new check list of Coleoptera, Mr. Sherman expressed the opinion that a number of the more distinct new species ought to be at once described, and suggested that I undertake the task. After some hesitation I agreed to make the effort and soon received from him a box containing good series of thirteen new species, of which he wrote: "These are sufficiently distinct, I believe, to be safely described without monographic work." To these I have added a number of others from my own collection, and a little later, when there shall have been time for further investigation, I hope to have something further to add concerning some more obscure forms.

Since the appearance of Dr. Sharp's monumental work on the Dytiscidæ—now thirty-five years ago—very little has been written concerning our own species of the family. Notwithstanding the great

value of this monograph, its use is very unsatisfactory to the American student as a guide to the identification of the species of his own fauna. Dealing as it does with the faunas of the whole world, and being almost destitute of dichotomous tables, it is altogether too cumbrous and indefinite for this purpose. Contributory to this state of affairs may be mentioned the fact that Sharp had been unable to secure anything like an adequate representation of North American forms, and was too often forced to base his opinions on but one or two examples of a species, and those not infrequently in poor condition. Even as late as 1902, in a letter to the writer, Dr. Sharp confessed to having "only a miserable representation of North American Dytiscidæ." It is moreover true that such genera as *Laccophilus*, *Calambus*, *Hydroporus*, *Ilybius*, etc., constitute more or less difficult studies, and even with our more abundant material no one has yet acquired sufficient familiarity with our species to venture a tabulation of them.

Types of all the new species described in the following pages are in the writer's collection, with the exception of *Hydroporus dixianus*, of which the type is in the Cornell University Collection at Ithaca, N. Y. Paratypes of this species are in my own and Mr. Sherman's collection.

Of all species sent for description by Mr. Sherman there are paratypes in his collection, and of these there are also paratypes in the collection of the American Museum of Natural History except *Calambus sylvanus*, *Hydroporus dixianus*, *H. tigrinus*, *H. var. suffusus* and *H. brevicornis*.

LACCOPHILUS.

The two following species are easily definable albeit the genus as a whole offers some puzzling problems to the systematist.

***Laccophilus inconspicuus* new species.**

Form nearly regularly oval; finely reticulato-alutaceous, moderately shining, subimpunctate; testaceous, the elytra uniformly ochreo-testaceous to brownish, without maculation; beneath testaceous throughout, or with the metasternum or abdomen or both darker. Antennæ filiform, but thicker than in allied species, the intermediate joints not or scarcely twice as long as wide, the terminal joint largely blackish. Front tarsi narrowly dilated in the male; coxal file entirely wanting. Length 4.3 to 4.7 mm.; width 2.4 to 2.6 mm.

The type is a male from Winnipeg, Manitoba, sent me by Mr. J. B. Wallis, and bearing date VI—3—11. Other examples before me are labeled Edmonton, Alberta (Carr), and Magnolia, Colorado (Henderson). Mr. Sherman—*in litt.*—gives the following additional localities. Higher altitudes of the White Mountains in New Hampshire (Lake of the Clouds, 5,000 ft.; Starr Lake, 4,890 ft.; Storm Lake, 4,930 ft.); Montreal, Quebec; Mt. Mansfield, Vermont; Marquette, Michigan; Three Lakes, Wisconsin. The Colorado specimens have the elytra of an ochreous color, noticeably paler than in the Canadian ones, but there seems to be no other difference.

In general appearance this species resembles *mexicanus* rather closely, but the latter is not so regularly oval, being a little more attenuate posteriorly; the elytra are closely irrorate, as is usual in the genus (not at all so in *inconspicuus*), the antennæ are more slender, the intermediate joints more than twice as long as wide, the terminal joint not darker; the metasternum blacker, the male with evident though fine coxal file; the size a little larger.

***Laccophilus schwarzi* new species.**

Form narrowly ovate, posteriorly attenuate, the point of maximum width in advance of the middle of the length; surface highly polished, glabrous, virtually impunctate except for a few fine punctures near the front of the pronotum, and the usual irregular series along the middle of each elytron; color rufotestaceous above and beneath, the elytra variegated with fuscous, a small diffuse fuscous spot at the middle of the front margin of the pronotum, a similar shade along the middle of the base, and beneath at the outer margin of the hind coxal plates. The color of the elytra may best be described as fuscous with testaceous markings as follows: An undulating subbasal transverse band often interrupted at the suture, an irregular discal quadrate spot at the apical third, between these several narrow longitudinal lines; and also the extreme apex. Antennæ and legs entirely pale. Front tarsi of male scarcely at all incrassate and with very few squamules beneath; coxal file entirely wanting. Length 3.9 to 4.2 mm.; width 2 to 2.2 mm.

Virginia (Ash Grove—type ♂); Maryland (Bladensburg—September).

Eight examples are before me, all submitted by Mr. Sherman. Of this species Mr. Sherman writes: "Originally found by Mr. Schwarz at Bladensburg, Md., and has been taken, so far as I know, only at the two places (mentioned above), both near Washington, and only in September, in the almost dried-up brooks, in eddies where fallen

trees or stumps have made dams in which there is an accumulation of dead leaves, etc., and upon surface of water a considerable collection of scum and rubbish.

Schwarzi is obviously allied to *undatus* Aubé, which is however a little less attenuate, less shining, with distinctly reticulated surface, more obscure and somewhat different elytral markings, prothorax and under side entirely pale, antennæ with terminal joint infusate.

I have been pleased to use for both this and the preceding species the appropriate MS. names given them by the late Mr. C. H. Roberts and by which it is likely they are known in certain collections.

BIDESSUS.

Bidessus quadripustulatus new species.

Broadly ovate, very convex, pointed behind; surface above polished and strongly shining (except the head); pubescence exceedingly short and sparse; above black, prothorax anteriorly yellow except in about the middle third; elytra each with two yellow spots, one subbasal, transverse, extending from side margin two thirds the distance to suture; the other subapical, oblique, oval. Antennæ piceous, basal three or four joints pale. Head alutaceous, finely sparsely punctate, finely margined in front. Prothorax more coarsely and closely punctate, the punctures gradually coarser toward the base; elytra still more coarsely punctate, the punctures separated, as a rule, by less than their own diameters; equally close but decreasing somewhat in size toward the sides and apex; sides of prothorax and elytra not quite continuous, the re-entrant angle, however, very broad and feeble, the former arcuate in front and strongly diverging posteriorly; elytra widest at about basal third, sutural stria entirely wanting. Body beneath piceous or rufopiceous; metasternum, coxal plates and abdomen basally, coarsely numerous punctate. Legs rufotestaceous, the tibiæ and tarsi usually darker. Length 2 to 2.2 mm.; width 1.15 to 1.25 mm.

California. San Bernardino Mts., July 12-13; five examples taken by the writer; sexes not certainly distinguishable.

This species is allied closely to *pictodes* Sharp, but is distinctly stouter and a little more convex than the latter, and the elytral spots are never so large. The basal thoracic and elytral striæ are similarly discontinuous, perhaps a trifle more so in the present species, while the elytral portion of the stria is here barely or scarcely as long as the thoracic portion, while in *pictodes* it is fully as long as the thoracic portion. The punctuation both above and beneath is observably coarser in *quadripustulatus*, and the sutural stria seems constantly lacking. In *pictodes* the sutural stria is traceable though faint.

Bidessus decoratus new species.

Closely similar to the preceding species, but apparently distinct by the following differences: Form just perceptibly less stout, punctuation perceptibly less coarse and close above, and more noticeably so beneath; sutural stria feebly impressed but clearly enough evident in basal two thirds by the serially arranged punctures defining a sutural interval which is abruptly, sparsely, very finely punctate; posterior elytral spot more elongate, and in the type interiorly emarginate. The basal elytral stria is very nearly continuous with that of the prothorax and is relatively a little longer than in *quadripustulatus*. Length 2.1 to 2.3 mm.; width 1.15 to 1.35 mm.

Arizona. Two specimens only are in my collection; the type recently collected in the Catalina Mts. by a correspondent of Dr. Fenyes, who has kindly turned it over to me; the second example bearing simply the label "Ariz."

This species must be very similar to the Mexican *Bidessus* (*Hydroporus*) *fryi* Clk., but if the statement made in the description of the latter that "the elytra are covered sparingly with minute punctures" is correct, it is hardly possible that they can be identical. In *decoratus* the elytral punctures are decidedly coarse for so small an insect, and are separated by scarcely more than their own diameters.

Our three broadly ovate quadrimaculate species may be briefly characterized as follows:

Elytra without sutural stria, form more broadly ovate, punctuation coarser and denser, notably so beneath; pale elytral spots occupying much less than half the entire area. San Bernardino Mts., So. Cal., 5,000 feet,

quadripustulatus.

Elytra with faint but traceable sutural stria, between which and the suture the punctures are not appreciably finer; elytral spots large, occupying as a rule more than half the entire area. Ventura, Cal., near the coast,

pictodes.

Elytra with feebly impressed sutural stria defined by punctures, between which and the suture the punctuation becomes abruptly very much sparser and finer; elytral spots occupying much less than half the entire area.

So. Arizona**decoratus.**

Bidessus ornatellus new species. .

Size and form nearly as in *affinis*, the elytra a little less pointed behind; upper surface subglabrous and strongly shining; general color ochreous yellow, elytra fuscous with antemedian and postmedian zigzag or undulating yellow fasciæ, the apex yellow; apical and basal margins of prothorax very narrowly infuscate, at least medially. Antennæ yellow with outer joints

dusky. Head alutaceous, minutely sparsely irregularly punctate. Prothorax with sides nearly straight and a little converging from base three fourths to apex, surface finely, sparsely punctate at sides, punctures closer at middle, especially posteriorly and along the apical and basal margins; basal striae strongly impressed, a little oblique, attaining the middle of the length. Elytra widest at basal two fifths, strongly, rather coarsely punctate, the punctures separated by about their own diameters; sutural striae distinctly impressed throughout, the space between them minutely sparsely punctate; basal striae parallel, nearly twice as long as the thoracic striae and continuous with them. Body beneath yellowish, the abdomen darker in the type; coxal plates and base of abdomen with sparse, coarse punctures. Length 1.95 mm.; width .9 mm.

Described from two examples of uncertain sex taken at Portland, Oregon, by Professor Wickham. This species is not very closely related to any of ours previously described, but may provisionally be placed near *subtilis*, which is of the same size and form and has a similar sutural stria. In *subtilis* there is a well-developed pubescence, the punctuation is much finer, and there is no appreciable disparity in size of the punctures between and without the sutural striae.

Bidessus floridanus new species.

Elongate, oval, not very much more obtusely rounded in front than behind; subglabrous, strongly shining; dull yellow, prothorax a little darker, elytra suffused throughout with brownish, diluted along the margins, and with a very obscure paler discal vitta. Head minutely remotely punctulate. Prothorax more strongly, somewhat unevenly and rather sparsely punctate, elytra more closely and coarsely so, sutural stria entirely wanting; basal stria distinctly shorter than that of the prothorax. Body beneath with a few fine scattered punctures on the coxal plates, and some coarser ones toward the abdominal base, for the most part serially arranged along the sutures; legs and antennae entirely pale. Length 1.75 to 2 mm.; width .8 to .9 mm.

Florida (Jacksonville and Dunedin). Three examples from the former locality, including the type, given me some years ago by Mr. Sherman; and two from the latter locality recently sent by Mr. Blatchley.

This species is most nearly related to *fuscatus*, in which the basal thoracic stria is similarly conspicuously longer than its continuation on the elytra. *Fuscatus* is also a stouter species, color beneath darker, form more obtuse in front, with sparser but coarser punctuation above, and with coarse punctures on the coxal plates. Some examples of *affinis* are rather similar, but these are more attenuate behind, more finely punctate, and the basal striae of the elytra and thorax are subequal in length.

***Bidessus suburbanus* new species.**

Ovate, polished, very finely and feebly pubescent, ochreous, elytra clouded with fuscous at base, narrowly so along the elytral suture, and with some more or less evident transverse discal clouds behind the middle; metasternum and abdomen—especially toward the base—brownish ochreous. Head and prothorax minutely sparsely punctate, the elytra a little more strongly so, the punctures separated from two to three times their own diameters; basal thoracic and elytral striæ as in *granarius*. Body beneath with a few minute scattered punctures. Otherwise nearly as in *granarius*. Dimensions of type: length 1.85 mm.; width .95 mm.

There is but slight variation in the series at hand. Fifteen examples are before me, all but one (including the type) from Staten Island, New York. One specimen is labeled "Penn."

Concerning the species, Mr. Sherman writes: "I have seen it only from Staten Island (taken in a pond in the woods no longer existing) and from Carbon Co., Pa., and from 'Pa.'"

Although closely related to *granarius*, it is abundantly distinct by its less broadly ovate form, less pointed behind, and finer sparser punctuation both above and beneath. The blackish shade at the base of the elytra is nearly wanting in *granarius*. There are no obvious sexual differences.

CÆLAMBUS.***Cælambus sylvanus* new species.**

Form rather narrowly ovate, widest before the middle, moderately convex, glabrous, both sexes shining; color castaneous, the antennæ, legs and under surface of head and prothorax brighter rufous. Head and prothorax finely, sparsely punctulate, the latter more strongly and closely so along the front and rear margins. Elytra widest a little behind the base, sides continuous in outline with the prothorax; punctuation not very close, consisting of intermixed, moderately coarse and much finer punctures. Metasternum, hind coxal plates, and sides of the basal ventral segments sparsely punctate, the punctures gradually diminishing in size from front to rear. Front and middle tarsi of male moderately dilated, a little narrower in the female; claws small and slender, unmodified in the male. Length 2.5 to 2.7 mm.; width 1.35 to 1.45 mm.

New York (Peekskill—Sherman). The type is a male bearing date 6—3—90. Of this species Mr. Sherman writes: "Known to me only from Peekskill; taken in a pond in the woods no longer existent."

The present species is very nearly allied to *C. laccophilinus* (wrongly described and recorded in the Henshaw List as a *Hydro-*

porus) of which I have specimens sent many years ago by Mr. Sherman, and bearing label "Peekskill, June 19, 1890," quite probably taken under similar conditions. *Laccophilinus* is larger and broader and evidently less convex than *sylvanus*; there is less disparity in the size of the elytral punctures and the females are opaque and more finely punctate.

HYDROPORUS.

Hydroporus triangularis new species.

Strongly elongate, convex, pointed behind, shining, subglabrous, the disk with very short and sparse appressed hairs, and along the side and near the apex a few long, excessively fine flying hairs. Color throughout yellowish testaceous, head slightly darker, elytra with brownish fuscous markings as follows: a transverse posteriorly convex basal spot, a broad subparallel-sided fascia at middle and another somewhat narrower subapical one, the two connected along the suture. Antennæ of moderate length, intermediate joints gradually thickened in both sexes, the fifth joint in the male enlarged, triangular, the outer edge sinuately oblique, the apical edge at right angles to the antennal axis. Head evenly convex, lateral impressions subobsolete, clypeus not thickened, punctures fine and very sparse on an excessively finely, densely punctulate ground. Prothorax slightly more than twice as wide as long, sides arcuate, very finely margined, the margin not thickened anteriorly; surface like the head very densely, minutely punctulate with scattered larger punctures. Elytra minutely reticulate and finely, sparsely punctate. Body beneath finely, sparsely, rather feebly punctate, the punctures coarsest on the metasternum, becoming very remote, fine and feeble toward the ventral apex. Prosternum gradually declivous in front, the median carina nearly attaining the front margin; metasternum grooved at summit; coxal lines parallel. Anterior tarsi narrowly dilated, scarcely wider in the male, in which the claws are unmodified. Length 3.75 to 4 mm.; width 1.75 to 1.9 mm.

Wisconsin (Sauk City) 4 ♂'s, 6 ♀'s. Specimens sent by Mr. Sherman are said to have been collected by Mr. W. S. Marshall. This remarkable species, though close to the one which follows, is otherwise very distinct from any other in our fauna.

Hydroporus pilatēi new species.

Closely related to the preceding species, differing as follows. Fourth and fifth antennal joints in the male conspicuously enlarged, the fifth larger than the fourth, longer than wide, the outer (posterior) edge rounded in apically, instead of sinuately produced to form an acute angle. The apical margin of the prothorax is infuscate, the punctuation of the upper surface even finer and sparser than in *triangularis*; the lower surface virtually impunctate in the usual sense, though with the same excessively fine, dense punctuation

as a ground sculpture, that prevails in *triangularis*. Length 4.2 mm.; width 1.9 mm.

The unique type was taken at Winnfield, Louisiana, by Mr. G. R. Pilate, from whom I received it.

Mr. Sherman (*in litt.*), alluding to the Sauk City, Wisconsin, species mentions having seen a specimen sent by M. Oberthur, of Rennes, France, labelled *Opelousa* La. It is more than likely that this specimen belongs to the present species rather than to *triangularis*.

The general facies of *pilatei* and *triangularis* is somewhat similar to *concinus* and allies, and the modification of the male antennæ in *diversicornis* of the *concinus* group suggests a relationship, so that, tentatively, the two species here described may be placed before *diversicornis*, though it must be confessed there is little else indicating such association.

Hydroporus cocheconis new species.

Of the *concinus* type; elongate, obtuse in front, rather pointed behind, flavo- to rufotestaceous, elytra with two broad, indented and more or less confluent transverse black fasciæ; integuments moderately shining, minutely reticulate, finely and evenly punctate throughout, the punctures separated on the average by twice their own diameters; pubescence very fine and sparse. Antennæ yellow, terminal joint largely blackish, the apices of one or two of the preceding joints occasionally dusky. Head feebly impressed each side, clypeus not thickened. Sides of thorax very feebly, evenly arcuate, margin moderately wide in front, much narrower posteriorly, disk with the apical margin infusate throughout the width of the head, base similarly but usually more narrowly infusate, sometimes not at all so. Elytra one half longer than wide, base with or without one or two black discal spots, the two broad black indented fasciæ (typical of the group) connected narrowly along the suture, and often at the middle of each elytron, more rarely again toward the sides; fasciæ not attaining side margins, the suture dark throughout. Body beneath and legs entirely rufotestaceous; metasternum and coxal plates coarsely rather closely punctate, first two ventrals less coarsely and closely so, third ventral moderately punctate, last three segments finely and sparsely so. Length 3 to 3.7 mm.; width 1.4 to 1.8 mm.

Described from a series taken by the writer at Farmington, New Hampshire, in July and August, in the gravelly shallows of the Coheco River.

There is no appreciable sexual difference in surface luster, and very little in the dilatation of the front tarsi, which are only moderately wide in the male. As in all species of the group, the anterior

claw of the front tarsus in the male is a little thickened, straighter, and slightly sinuate interiorly; the modification is however feeble. *Cochconis* is separable from the other members of the *concinus* group by the very coarsely punctate metasternum and coxal plates.

Hydroporus ohionis new species.

Of the *concinus* group and similar to the preceding except as follows: The prothorax is rufocastaneous, with the front and hind margins blackish, head slightly to scarcely paler, elytra pale flavotestaceous with the usual broad, irregular transverse black fasciæ. Body beneath rufopiceous, legs rufotestaceous. Prothorax more finely and sparsely punctate at the middle of the disk than elsewhere (this difference being scarcely obvious in *cocheconis*); elytra slightly more coarsely and sparsely punctate than in *cocheconis*, and very distinctly more so than in *concinus*; metasternum and coxal plates less coarsely and more sparsely punctate than in *cocheconis*, but more coarsely so than in *concinus*. Length 3.2 mm.; width 1.5 mm.

Cincinnati, Ohio. Three males, collected by Chas. Dury, and sent me many years ago mixed with examples of what we now regard as *concinus*. The latter averages larger, the prothorax and head concolorous with, or only slightly darker than the elytra, the lower surface piceous.

Hydroporus shermani new species

Narrowly ovate, male moderately shining, female with duller luster, pubescence obvious, color rufotestaceous above and below, pronotum with apical marginal fuscous spot, elytra with shorter basal and two broad uneven discal fasciæ irregularly connected longitudinally, so as to leave the sides at base, an antemedian and a postmedian interrupted fascia made up of longitudinal spots and dashes of variable length, and the apex pale. Antennæ of moderate length, the terminal joint and the apices of several preceding more or less infusate. Head finely, rather closely punctate, lateral impressions broad but distinct, clypeus not very evidently thickened, its posterior margin not very distinctly defined at middle. Prothorax rather finely but strongly, moderately, closely punctate, sides broadly, evenly arcuate, thickened margin narrow. Elytral punctures equal to those of the prothorax, their distances apart varying from one and a half to two times their own diameters. Prosternal anterior intercoxal declivity abruptly formed, but not strongly protuberant at summit; metasternum and coxal plates coarsely, rather closely punctate; ventral segments moderately strongly, not closely punctate, becoming finely, sparsely so toward the apex; coxal lines gradually, rather strongly divergent in front. Front and middle tarsi very broadly dilated in the male, evidently narrower but unusually wide in the female; anterior claw of front tarsus in the male thickened and only half as long as the posterior one. Length 3.4 to 3.6 mm.; width 1.7 to 1.75 mm.

The series before me comprises 2 males and 4 females from Staten Island, New York; 2 females from Gettysburg, Pa. (Devil's Den), and a male from Atoka, "Ind. T." (Wickham).

The Staten Island and Gettysburg specimens were all taken in fresh running water, according to Mr. Sherman, from whom they were received, and to whom in recognition of long friendship it gives me great pleasure to dedicate the species.

In the greatly abbreviated anterior claw of the front male tarsus, *shermani* agrees nearly with *clypealis*, the latter, however, is a distinctly more broadly oval species, with distinctly thickened clypeus and the side margins of the prothorax in the female sinuate at the anterior angles. In its more elongate form *shermani* agrees closely with *concinuus* and allies.

Hydroporus dixianus new species.

Moderately broadly ovate, strongly shining, very finely and sparsely pubescent, flavotestaceous, elytra with diffuse or ill-defined fuscous vittiform markings; punctuation above fine and sparse throughout, the elytral punctures showing a tendency to become connected transversely so as to form a feeble wavy strigosity. Antennæ entirely pale; head feebly impressed, the clypeus not thickened. Thoracic side margins very fine, a faint shade at the middle of the apical margin, and sometimes very narrowly along the basal margin. Elytra widest but little behind the base, apex pointed. Body beneath uniformly rufotestaceous, prosternum without anterior intercoxal protuberance; metasternum rather deeply channeled medially, sides moderately coarsely, closely punctate; coxal plates less coarsely and closely punctate, becoming rather widely smooth posteriorly; ventral segments very finely and sparsely punctate except near the base. Anterior tarsi only moderately dilated, the middle tarsi evidently narrower. Length 3 to 3.2 mm.; width 1.6 to 1.7 mm.

Georgia (Spring Creek, Decatur Co., 26-28 Aug., '13).

The type series consists of six examples collected by Mr. J. C. Bradley, and sent me by Mr. Sherman. The type itself is returned to the Cornell University Collection at Ithaca, N. Y. There are no sexual differences observable.

The species is evidently closely related to *mellitus*, the form, color and markings being nearly identical in both; *mellitus* is, however, a distinctly smaller species, the punctuation of the upper surface everywhere less fine, the elytra not showing the feeble transverse strigosity observable in *dixianus*, and the metasternum rather more coarsely and uniformly punctate. The resemblance of *dixianus* to *vittatipennis*

(*lincolatus* Lec.) is also quite marked, but the latter is narrower, fully to more than twice as long as wide, with better defined elytral vittæ, and with the posterior coxal processes more closely appressed to the ventral surface.

***Hydroporus dilatatus* new species.**

Broadly ovate, shining, thinly pubescent, flavo- to rufotestaceous; elytra with heavy black markings of the *undulatus* type; antennæ, legs and under surface entirely pale. Head more distinctly alutaceous and less shining than the prothorax and elytra, finely punctate, impressions moderate, clypeus feebly thickened. Prothorax rather narrowly margined at sides, which are nearly straight; punctuation moderate, subevenly distributed, the punctures separated by more than their own diameters as a rule; a small, somewhat diffuse dark spot at the middle of the apical margin, and the basal margin narrowly infusate in middle half. Elytra one third longer than wide, margin continuous with that of the prothorax, slightly prominent at the humeri, thence straight and parallel or even faintly sinuate to a point just before the middle, broadly arcuately convergent and somewhat pointed posteriorly; punctuation similar to that of the prothorax, fuscous markings predominant, and so disposed as to leave an irregular subbasal pale fascia which broadens out at the margins, and on the disk is made up of transversely confluent longitudinal spots or dashes; a similar postmedian fascia and apex pale. The suture is entirely dark and the lateral margins are pale throughout. Metasternum and coxal plates rather coarsely, evenly, not densely punctate, the first two abdominal segments punctured nearly as the coxal plates, following segments gradually, more finely punctate; prosternal anterior intercoxal protuberance obsolete. Front tarsi moderately dilated, only very slightly more so in the male, in which the anterior claw is a trifle shorter, stouter, and feebly sinuate internally. Length 4 to 4.4 mm.; width 2.2 to 2.35 mm.

Maryland (Bladensburg, September 21—type ♂—Sherman); Massachusetts (Tyngsboro, August 31–September 5, Blanchard); New Hampshire (Farmington, August 21).

I have used for this species Zimmermann's MS. name, which is attached to a specimen in the Cambridge Museum. Mr. Sherman's specimens were taken in running brooks at Bladensburg, Maryland. Mr. Blanchard and I have taken it in a small meadow brook at Tyngsboro, Mass.; and the New Hampshire specimens were taken by the writer in the Cocheco River, a small clear stream with gravelly bed.

This species may be recognized by its broad ovate form, shining surface and rather distinctly contrasting markings (except in var. *suffusa*). *Spurius* Lec. (*peltatus* Sharp) is similar in form, size and markings, and at Tyngsboro, Mass., and Farmington, N. H., occurs

in the same streams with *dilatatus*: it differs from the latter in its generally paler yellow color, immaculate thorax, still more sharply contrasting elytral markings, and especially by the impressed discal lines on the elytra, with feeble intercostæ.

The following dark form has been considered a distinct species by Mr. Sherman, but the agreement in all essentials with typical *dilatatus* is so complete, that I am at present unable to see in it anything more than a suffused variety.

Var. *suffusus* new variety.

Similar to the typical form in most respects except color. The basal and apical thoracic dark areas are here extended and become almost confluent on the median line; dark markings of elytra broadly suffused, so as to obscure or obliterate the transverse pale fasciæ, which in the type are represented by a single small rufous spot at their outer extremities. In other examples the pale fasciæ are more complete, but smaller, more obscure and broken. The size is a little smaller on the average than in the typical form, and some females are apparently a little duller. Length 3.85 to 4.1 mm.; width 2.1 to 2.35 mm.

New Jersey (Eatonton, July 4), 3 ♂'s, 3 ♀'s, sent by Mr. Sherman, who writes that it occurs in running brooks.

Hydroporus sulcipennis new species.

Form moderate, subovate, scarcely as broad as in *undulatus*, and a little more pointed behind; surface finely alutaceous but moderately shining in both sexes, pubescence fine and thin; punctuation above rather fine, nearly uniform, the punctures separated on the average by about one and one half times their own diameters, finer and sparser on the head. Color flavo- to rufo-testaceous; prothorax with the posterior margin very narrowly infusate in median half, and with or without a small diffuse fuscous spot or shade at the middle of the apical margin; elytral markings of the usual type, occupying one half to three fourths the superficial area, rather sharply defined. Head broadly feebly impressed each side, clypeus scarcely thickened. Antennæ entirely pale. Prothoracic margins narrow, scarcely wider in front. Elytra each with three longitudinal impressed lines or sulci, the middle one deepest, the inner one subsutural, the outer one at the middle of the elytron. Body beneath entirely pale, anterior intercoxal prominence of prosternum subobsolete; metasternum and coxal plates very grossly, moderately, closely punctate; the first and second ventral segments similarly but somewhat less coarsely so. Front tarsi of male moderately dilated, a little more strongly so than in the female, the claws equal, the anterior one a little stouter, their inner margins slightly bisinuate. Length 3.5 to 4 mm.; width 1.8 to 2.1 mm.

Twenty-one examples are before me, from the following localities:

New Hampshire (Farmington, August 4, type ♂; Randolph, 1,300 ft.; Sherman); Vermont (Bennington—Sherman); New York (Peekskill—Sherman); District of Columbia; Virginia (Ash Grove—Sherman).

A not uncommon species, occurring always, according to Mr. Sherman, and in my own experience, in running water. *Sulcicipennis* is very nearly related to *spurius*, but is smaller and distinctly narrower, the elytral sulci more pronounced, the punctuation of the inferior surface even coarser. It is immediately separable from all our other species of *Hydroporus* by the elytral sulci.

Hydroporus semiflavus new species.

Oval, moderately elongate, flavotestaceous, male moderately shining, female dull; pubescence yellow, distinct, but less dense than in the closely allied *sericeus*. Antennæ entirely yellow, or with only the tip of the terminal joint dusky. Head closely, finely punctate, clypeus evidently but not strongly thickened. Prothorax similarly and not much more coarsely punctate than the head, side margins moderate, a transverse fuscous spot at the middle of the apical margin, the base also narrowly infusate in middle half. Elytra one half longer than wide, widest at about the basal third, rather closely punctate, the punctures as large or slightly larger than those of the prothorax, and separated as a rule by their own diameters. The markings are fuscous or blackish, and consist of an entire sutural stripe dilated at middle and again before the apex, a spot on each at the middle of the base, behind which and narrowly separated from it is a broad longitudinal dash extending to a little beyond the middle, and near its posterior end connected transversely with the sutural stripe; a shorter longitudinal spot external to the preceding and an irregular transverse subapical spot. Metasternum and coxal plates coarsely, rather closely punctate. Anterior tarsi rather strongly dilated, a little wider in the male, in which sex the claws of the front tarsi are evidently stouter and more curved, the anterior claw a little thicker and about three fourths as long as the other. Length 3.8 to 4 mm.; width 1.9 to 2.1 mm.

Illinois (Glencoe), 3 ♂'s, 5 ♀'s—type ♂—sent by Mr. Sherman; Missouri (Pine), a single male in my own collection, from an unrecorded source.

This species is rather closely allied to a number of others, of which we may best select for comparison two neighboring species from the north and west—*sericeus*, inhabiting the Upper Lakes region, and *mixtus*, from Kansas and Nebraska. From these and all other closely allied forms (except *placatus* n. sp.) *semiflavus* may be primarily

recognized by the broader, simpler elytral markings, which leave on either side of the sutural stripe an anterior suboblong pale space, conspicuous in all examples before me, but which in allied species is much narrowed or broken up by the dark markings. *Mixtus* is a slightly larger species of a darker rufotestaceous color, the dark areas of the elytra predominating (dark and pale areas about equal in *semiflavus*), the form slightly different, the elytra being a trifle more pointed behind, with the point of maximum width nearer the base; the punctuation of the head finer and sparser, that of the elytra a trifle sparser and coarser, and of the metasternum slightly sparser than in *semiflavus*. *Sericus* has the more nearly elliptical form of *semiflavus*, and a similar though more pronounced golden pubescence; in size it is distinctly larger and the elytral markings are more numerous and pronouncedly vittate in character; the punctuation of the metasternum and coxal plates is rather finer but denser than in *semiflavus*. In both *mixtus* and *sericus* the anterior tarsal claws of the male are nearly as in *semiflavus*. For comparison with the very closely allied *placatus*, see the following:

***Hydroporus placatus* new species.**

Very closely allied to the preceding species, between which and *sericeus* it divides allegiance. Its size is scarcely as great as *sericeus*, but evidently larger than *semiflavus*. Its markings are those of *semiflavus* except that there is a tendency to suffusion on the elytra which diminishes the size of the anterior subsutural pale area and in some examples more or less completely obliterates the postmedian discal pale markings. The dark spot at the apical margin of the thorax is small, occupying about the middle third of the width as in *semiflavus*; it is much more extended in *sericeus*. The punctuation of the elytra is evidently finer and denser than in *semiflavus*, and that of the under surface is also denser, though scarcely appreciably finer than in the latter. In *sericeus* the punctuation above is nearly as in *placatus*, while that below is somewhat finer though about as dense. Length 3.9 to 4.3 mm.; width 2 to 2.2 mm.

Oregon (Corvallis), 1♂ (type), 4 ♀'s; my own collection.

In the single male, the front claws are a little stouter and more suddenly bent, and a little sinuate on their inner margins, the anterior claw just perceptibly shorter. In *semiflavus* the front claws of the male appear to be a little more unequal and scarcely at all sinuate. In *sericus* the inequality is a trifle more evident, the front claw not sinuate, the rear one somewhat so. Possibly these differences would not hold constant in a long series.

Hydroporus arizonicus new species.

Ovate elliptical, finely pubescent, flavotestaceous, elytra with vittiform markings of the *sericeus* type, luster dull in the female and scarcely more shining in the male; punctuation of thorax and elytra dense, the punctures separated by less than their own diameters or nearly in contact, punctures of head finer and less dense. Front very distinctly impressed each side, clypeus somewhat thickened. Prothorax with broad side margins, disk with a somewhat diffuse brownish cloud occupying the middle third or more, and extending from base nearly or quite to the apex. Elytra less than one half longer than wide, the sides straight and parallel for nearly half their length from a point just behind the base. The elytral vittæ, as in *sericeus*, consist of longer and shorter dashes which are variably coalescent, both longitudinally and transversely, the darker areas as a rule predominant. Body beneath coarsely, densely punctate, the punctures at corresponding parts evidently coarser and rather denser than in *sericeus*. Front tarsi of male rather widely dilated, with claws a little thicker, straighter, and slightly sinuate on their inner edge; the anterior one just perceptibly shorter. Length 4.6 to 5.2 mm.; width 2.35 to 2.55 mm.

Arizona (Tucson). Ten examples from the Sherman and Roberts collections. The type is a male.

This species is most nearly related to *sericeus* and *dimidiatus* but is larger than either, with sides of elytra more parallel basally. The prothoracic discal cloud will at once separate it from any allied form. In *dimidiatus* the prothorax is entirely pale, at most with the extreme basal edge very narrowly infusate at middle. In *sericeus* both apical and basal margins are distinctly blackish except at sides.

Hydroporus tigrinus new species.

Size small, moderately elongate, subovate, sparsely, finely pubescent and moderately shining, though with the usual finely alutaceo-reticulate ground sculpture; rufotestaceous, the abdomen commonly darker rufous or rufopiceous at sides, especially basally; elytral disk predominantly fuscous, with confluent linear markings. Head entirely rufotestaceous, finely, sparsely punctate and distinctly biimpressed, clypeus not appreciably thickened. Antennæ moderate, entirely pale except for the apical half of the terminal joint. Prothorax finely and sparsely punctate medially, becoming rather closely and strongly so at base and apex, side margin rather wide; a small diffuse fuscous spot at the middle of the apical margin, basal margin usually narrowly infusate in middle half, sometimes scarcely at all so. Elytra widest at about basal fifth, moderately, arcuately attenuate posteriorly, punctuation at base rather coarse, becoming gradually very fine at apex, the punctures separated on the average by twice their own diameters, somewhat closer basally. The markings may be described as vittiform in character, more or less transversely con-

fluent at base, again in a broad median indented fascia, and finally to form a transverse subapical blotch, leaving a subbasal and a postmedian transverse series of elongate spots or streaks, the side margin basally and the apex pale. Metasternum very coarsely not closely punctate; coxal plates similarly coarsely punctate basally, becoming gradually much more finely and sparsely so postero-externally; first and second ventral segments strongly but sparsely punctate except at sides of latter, the following segments very finely sparsely punctulate. Length 2.95 to 3.1 mm.; width 1.48 to 1.55 mm.

Virginia (Ash Grove), 4 ♂'s, 3 ♀'s, sent by Mr. Sherman. The type is a male.

The sexes are barely distinguishable by the very slightly stouter and just perceptibly sinuate front claws of the male. There is no apparent difference in surface luster, and the front tarsi are rather narrowly and equally dilated in both sexes.

Mr. Sherman writes of this species: "Like specimens in the Cambridge Museum labeled '*tigrinum* Zimm. MS.' Has been taken in running brooks with *blanchardi* Sherm. and *striatopunctatus* Melsh, but less common than either of these species."

Oddly enough, this little species is probably more nearly related to these same two species which Mr. Sherman says occur with it, than to any others in our fauna. That the species described by Sharp as *H. vitiosus* Lec. is not the true *vitiosus* was discovered, and referred to in notes taken by the writer in July, 1900, while making comparisons with some of the Leconte types at the Cambridge Museum. Mr. Sherman has recently¹ proposed the name *blanchardi* for this species.

It is, of the two species mentioned, most nearly allied to *tigrinus*. It is slightly larger and more depressed, the form more ovate, *i. e.*, more pointed behind, with the point of greatest width more nearly at the base of the elytra; the markings more obscure as a rule, the punctures of the thorax more uniform in size, and those of the elytra less conspicuously diminishing in size apically; the punctuation of the metasternum and coxal plates is obviously finer than in *tigrinus*. *Blanchardi* has been taken plentifully at Tyngsboro, Mass., by the late Frederick Blanchard and myself, and is known to me also from Conn., N. J., Pa., Va., and Ala.

¹ JOUR. NEW YORK ENT. SOC., XXI (1913), p. 52.

Hydroporus carolinus new species.

Form rather broadly ovate, less than twice as long as wide, shining, sparsely, finely pubescent; head, thorax, antennæ and legs rufous, elytra brownish piceous with faint diffuse rufous spots at sides near the base (sometimes completely wanting), a postmedian lateral irregular rufous spot, and the tip more or less obscurely rufescent. Prothorax slightly infusate along the basal margin and with a small diffuse fuscous spot at the middle of the apical margin. Antennæ entirely rufotestaceous. Head biimpressed as usual, finely punctate, clypeus feebly thickened. Prothorax widely margined at sides, rather coarsely, nearly uniformly punctate, the punctures separated by from one to one and one half times their own diameters. Elytral punctuation similar to that of the prothorax, but slightly coarser. Metasternum and coxal plates very coarsely, not closely, punctate; apical margin of postcoxal processes angularly prominent at middle. Front and middle tarsi of male moderately and nearly equally dilated, the claws of the front feet evidently stouter and more suddenly bent, but mutually equal. Length 3.75 to 4.1 mm.; width 2 to 2.2 mm.

North Carolina (Highlands, June, '88).

Described from a single pair (type ♂) given me by the late Frederick Blanchard, by whom they were collected.

The combination of characters diagnostic of this species, are the ovate form, obscurely marked elytra, coarse punctuation, wide thoracic side margins, and slightly stouter equal front claws of the male. It is most nearly related to *mixtus* Lec. The latter is of nearly similar form, but the rufous color is brighter, the elytral markings conspicuous, the side margins of the thorax narrower, the punctuation a little less coarse, the front tarsal claws of the male unequal.

Hydroporus brevicornis new species.

Elongate oval, shining, sparsely, finely pubescent, broadly fuscocastaneous on the disk, gradually changing to rufocastaneous at the margins. Head rufous in front, darker posteriorly, finely, sparsely punctate, distinctly biimpressed, clypeus not thickened. Antennæ unusually short, scarcely passing the hind angles of the thorax, the intermediate joints but little longer than wide, rufous at base, becoming more or less completely infusate apically. Prothorax finely margined at sides, posterior lobe prominent, very sparsely, finely punctate at the middle of the disk, more strongly and closely so toward all the margins. Elytra a little more coarsely punctate, nearly evenly so from base to apex, the punctures separated by from one to two times their own diameters. Beneath, prothorax, epipleuræ and legs rufous, metasternum black, abdomen piceous with tip and lateral spots on last three or four segments, rufous. Prosternal anterior intercoxal prominence moderate, metasternum nearly flat along the median line; postcoxal processes conjointly sub-

truncate, their tips not in the least sinuate, and consequently not at all prominent on the median line. Metasternum finely, sparsely punctate at middle, more coarsely and closely at sides; postcoxal plates and first two ventral segments rather sparsely, moderately coarsely punctate, following ventrals more finely and sparsely so. Length 3.35 to 4 mm.; width 1.7 to 1.85 mm.

Of this species there are before me five examples (including the type) from Starr Lake, 4,890 ft., White Mts., N. H. (Sherman); one example from Randolph, N. H. (Sherman); one from Farmington, N. H., collected by the writer, and one from Tyngsboro, Mass. (Blanchard).

There are no obvious sexual differences in the eight specimens at hand. In all, the front tarsi are moderately broad with the joints slightly decreasing in width from the base, the middle evidently narrower with the joints more conspicuously diminishing in width. The third joint of the middle tarsus is moderately emarginate superodistally for the reception of the terminal joint but does not seem to be truly bilobed, the terminal joint projecting beyond the third a greater distance than the length of the latter. The claws of the front tarsi are mutually equal, not appreciably stouter, but distinctly shorter than those of the middle tarsi.

Concerning this species, specimens of which were sent to him by the writer in 1902, Dr. Sharp wrote: "Unknown to me; seems not very near anything." It is really quite similar in general aspect to two or three species of the *americanus* type, but is slightly smaller than these, and at once separable by the shorter antennal joints.

Hydroporus dentellus new species.

Moderately elongate oval, moderately shining in both sexes, evidently pubescent; dark brownish piceous, the prothorax and sides of the body anteriorly becoming gradually rufopiceous, the head rufous; in some examples, perhaps less mature, the upper surface is brownish testaceous. Body beneath dark rufopiceous, the sides and apex of abdomen gradually somewhat paler; prothorax rufous, legs dark rufous. Head finely punctate, feebly impressed, clypeus not thickened. Antennæ moderate, rufotestaceous at base, the outer joints more or less completely infusate. Prothorax finely margined at sides, disk sparsely, finely punctate, more coarsely and closely so toward all the margins. Elytra evenly, not very finely punctate, the punctures separated by from one to one and one half times their own diameters as a rule, being, as is often the case, a little closer transversely than longitudinally. Body beneath more coarsely but rather sparsely punctate, the abdominal punctures finer and sparser at the middle and toward the sides posteriorly, as usual.

Anterior claw of front tarsus acutely dentate in the male. Length 3.8 to 4.3 mm.; width 1.8 to 2 mm.

Massachusetts, Tyngsboro, July–August, 5 ♂'s, 4 ♀'s; Marion, 1 ♂; New Hampshire, Farmington, 1 ♂. The type is a Tyngsboro male.

The species belongs to the *americanus* group, but is at once distinguished from allies by the toothed anterior claw of the male front tarsus. The species is not rare at Tyngsboro in various ponds and springs.

***Hydroporus melsheimeri* new species.**

Form rather broadly ovate, widest at or near the anterior third, or but little behind the elytral base; distinctly pointed behind; color rufopiceous, becoming gradually paler toward the sides of the elytra basally, and along the lateral and anterior margins of the thorax, head rufous; surface finely, sparsely pubescent and shining. Antennæ moderate, the outer joints more or less infusate. Head finely, sparsely punctate, moderately biimpressed, clypeus not thickened. Prothorax rather finely margined at sides, finely, sparsely punctate at middle and in front, more strongly and closely posteriorly. Elytra rather finely, not closely, punctate. Beneath piceous, venter either entirely rufous or with the basal segments infusate, propleuræ and legs rufous. Front and middle tarsi of male moderately broadly dilated, the claws of the anterior tarsi not appreciably modified, and mutually subequal, the front claw at most only just visibly shorter. Length 3.25 to 3.75 mm.; width 1.75 to 2 mm.

Massachusetts, Tyngsboro (type ♂) and Marion; 3 ♂'s, 7 ♀'s.

This species is closely allied to *dichrous* Melsh., but is a little smaller, evidently more broadly ovate, and less finely punctate. In *dichrous* the prothorax as well as the head is as a rule uniformly rufous, the venter—in fully colored examples—is piceous, except narrowly at sides and tip; the front tarsi of the male are slightly wider, and there is a marked sexual disparity in this respect, the middle tarsi especially being conspicuously narrower in the female, while in *melsheimeri* the middle tarsi of the female are very nearly as widely dilated as in the male. In *dichrous* the front claw of the anterior tarsus is considerably shorter than the other.

ON MERIUM AND SOME BLUE CALLIDIUM (COL.).

BY CHAS. SCHAEFFER,

BROOKLYN, N. Y.

Merium proteus Kirby.

Merium bifossulatum Casey, Mem. Col., III, 1912, p. 286.

The characters given in the description of *bifossulatum* to separate it from *proteus* do not hold good. I have *proteus* from Hudson Bay Territory and a moderately large series from Alaska collected some years ago by my brother. In these the coloration and especially the sculpture of prothorax and elytra differ greatly. The color of prothorax may be bluish or greenish and the elytra has either a bluish or greenish tint or is entirely pale without any metallic reflection. The sculpture of prothorax of the females is extremely variable; not two specimens of my series are alike. One specimen has the disk of prothorax entirely smooth except at apex, with one puncture on each side of the median line; another specimen, the extreme of my series, is rather heavily punctured on each side of the median line from apex to nearly to base, defining not only a broad, smooth median line but also a smooth line on each side near the rugosely punctate lateral area. The "subtransverse concavities" on the posterior part of prothorax may be more or less distinct or absent and more or less heavily punctured or smooth. The females seem to be much more variable than the males; the latter, at least in my series, show very little variation in regard to the sculpture of prothorax. The median part of prothorax is smooth and either with a few or without any punctures; the antennæ are a little longer and slightly stouter, the femora a little more clavate and the lateral area slightly more finely sculptured in the male than in the female. The sculpture of elytra in both sexes is also variable especially in about apical half.

Callidium antennatum Newm.

The form of prothorax differs much in this species, also the length of antennæ. The sculpture of elytra varies to some extent and the raised lines may be present or not. A single specimen from Oregon does not differ from typical *antennatum*.

Callidium antennatum hesperum Casey.

This variety or subspecies is separated from typical *antennatum* in having shorter antennæ, the elytra more shining and deeply and coarsely punctured. The length of antennæ varies in typical *antennatum*; they may be "fully as long as the body" or shorter; however, I have a male from Eldridge Co., Cal., which has the antennæ fully as long as the body. The sculpture of elytra of the California specimens of this form which I have seen differs very much from those of typical *antennatum*. Specimens from Colorado in Mr. Leng's collection have the elytra less coarsely punctured and a little less shining than typical *hesperum* and differ very little from certain specimens of *antennatum*.

Callidium schotti new species.

Oblong, subopaque, dark blue, outer joints of antennæ, palpi and tarsi black. Head coarsely, moderately closely punctate; antennæ reaching beyond middle of elytra in the male, in the female to about middle of elytra. Prothorax transverse; sides arcuate and rather feebly narrowing towards apex, strongly narrowing from a little below middle to base; the lateral area on each side densely rugosely punctate and opaque in the male or less coarsely and a little more closely punctate than at middle in the female; the median part slightly more shining and with rather coarse punctures. Elytra oblong, sides nearly parallel, apices obliquely rounded; surface more coarsely and deeply punctured than in *antennatum*. Prosternum a little more coarsely sculptured than in *antennatum*. Length 12.5 mm.

Huntington, Long Isld. (Schott), North Carolina (Leng). The types, male and female from Long Island in the Museum collection, paratypes in the collection of Chas. W. Leng.

This distinct species looks superficially like *antennatum* but has shorter antennæ, and in the male, the line separating the lateral area from the median part less distinct and less strongly sinuate, the median part shining and coarsely and moderately closely punctate, the femora, especially the posterior one, more abruptly dilated with the club rather shorter and the hind tibiæ a little more curved; in the female the prothorax is more closely punctate than in the male, and the line separating the lateral area scarcely evident. While this species is a little more shining than *antennatum*, it is much less shining than *violaceum* (*janthinum*), *frigidum* and *californicum*.

Callidium violaceum Linn.

C. janthinum Lec. Journ. Acad. Nat. Sciences, Phila., ser. 2, Vol. II, p. 34.

Leconte in his remarks following the description of *C. janthinum* says that this and *antennatum* differ from the European *violaceum*, but I am unable to see any difference between two European specimens of *violaceum* and a series of American specimens of *janthinum*.

The long series before me, about forty specimens, loaned me by Messrs. Davis, Frost, Leng, Shoemaker and Schott show great variation in form as well as sculpture of prothorax. The prothorax in some specimens is rather broad, in others small; the sides broadly rounded, in others subangulate; the lateral area may be more or less coarsely and rugosely punctate or more or less distinctly granulate. The color of elytra may be violaceous, dark blue or greenish blue.

This species has longer and less suddenly clubbed femora than any other species.

Messrs. Davis and Shoemaker collected a large number of specimens at Whiteface Mt., N. Y.; also a few at Rockaway Beach, Long Island. A single specimen in the Museum collection is from Brooklyn, N. Y. Mr. Frost has taken this species at Framingham, Mass.; also at Paris, Maine, and specimens from Maine and Quebec are in Mr. Davis's collection. Mr. Leng has specimens from Vermont and one from Texas, which latter locality, however, is evidently a mistake. A single specimen from Stephenville, Newfoundland, collected by G. P. Engelhardt, is in the Museum collection.

Callidium texanum new species.

Similar in form to *violaceum* (*janthinum*); color dark blue, antennæ and under side black or piceous with scarcely a bluish tint; femora and tibiæ more or less bluish. Head coarsely and subconfluently punctate; antennæ reaching to about middle or a little beyond middle of elytra and nearly similar in both sexes, the joints a little stouter and the last four a little longer in the male than those of the female. Prothorax transverse; sides gradually, arcuately narrowing from a little behind middle to apex, more strongly narrowing to base; surface coarsely and closely punctate at middle, at sides more finely and subrugosely punctate in the male, in the female the punctures at sides are coarser than in the male, but still smaller than at middle. Scutellum scarcely transverse and rather rugosely punctate. Elytra about two and one half times as long as prothorax; sides parallel; apices broadly obliquely rounded; surface coarsely and confluent punctate, the punctures less close near base. Prosternum coarsely punctate in the male, sparsely punctate and shining in the female; intercoxal process rather coarsely, transversely strigose. Length 10 mm.

Texas. Types, male and female in the Museum collection, paratypes in collection of Chas. W. Leng and Wm. T. Davis.

This species differs from *violaceum* in generally smaller size, different sculpture of prothorax, shorter antennæ and femora and more coarsely confluent punctate elytra. From *frigidum* it differs in being a little more depressed, less shining and male antennæ shorter and a little stouter, the posterior femora of the male more distinctly curved, the lateral margin of elytra narrowly reflexed and surface more densely punctate, the scutellum is apparently more transverse and may be more or less concave or not.

A single specimen in not very good condition from Ohio in the collection of the late Ottomar Dietz agrees pretty well with the specimens from Texas, except that the median part of prothorax is shining with the coarse punctures very well separated. I have placed this specimen for the present with this species as *violaceum* and especially *frigidum* exhibit great variation in punctuation of the prothorax.

***Callidium frigidum* Casey.**

This species was described from the female. The male differs very little from the female except as usual in stronger clavate femora, longer and stouter antennæ, more finely rugose and somewhat opaque lateral area of prothorax and somewhat coarsely and moderately closely punctate prosternum. The prothorax in this species is variable as in *violaceum* but not so much in form as in punctuation. Mr. Frost has loaned me the two extremes of a series in his collection of which one has the prothorax coarsely and subconfluent punctate with a narrow smooth line at middle and the other specimen has the median part smooth and shining with scarcely any punctures.

Numerous specimens of this species were taken by Messrs. Engelhardt and Shoemaker in the show window of a rustic furniture store in Fulton Street, New York City; Mr. Frost has taken this species in Paris, Maine, and Mr. Leng has specimens in his collection from New York, Massachusetts, and Bangor, Maine. The type of this species came from Canada.

All the available records show that this species breeds in Cedar.

***Callidium californicum* Casey.**

The description of this species was drawn from a male. A female in my collection from Fresno Co., Cal., agrees pretty well with the

description except that the antennæ are shorter and the sculpture of prosternum is similar to that of the female of *frigidum*. It is nearest allied to *frigidum*, but the lateral area of prothorax is less coarsely sculptured and the lateral margin of elytra scarcely at all reflexed.

***Callidium lacustre* Casey.**

This species was described from a single specimen, a female, from Bayfield, Wisconsin. It is unknown to me, at least, a single specimen which I refer doubtfully to this species has the prothorax below distinctly metallic blue and the sides of prothorax are not subangulate, but rather broadly rounded. However, in not fully developed specimens the underside usually shows scarcely a sign of metallic luster and as shown above the form of prothorax is more or less variable. The specimen in question looks superficially like a small *violaceum* but the sculpture of prothorax is different and the hind femora are shorter and more suddenly clubbed than in that species; it is, however, more closely related to *frigidum* but has longer antennal joints than that species.

COLLECTING BEES IN SOUTHERN TEXAS.

BY WILMATTE P. COCKERELL,

BOULDER, COLORADO.

There are only two seasons in Colorado, the pessimists say, summer and winter; and even the greatest admirer of Colorado weather must wish that spring, always late in coming, was not a succession of frosts and snowstorms. So it was with a distinct feeling of pleasure that I left Boulder, Colorado, the last day of March, to spend a few days in San Benito, Texas, a small town near the Mexican border.

The maples were in blossom in Boulder, the catkins of the willows were still in their smallest "pussy" state; sheltered by rocks on warm hill slopes a few pasque flowers and spring daisies (*Toxensandia*) were blossoming, and honey bees and a few venturesome *Andrena* flew about—signs that spring might come, indeed, though as I write this near the tenth of May there are still no leaves on the trees, and no wild bees flying. Kansas was weeks ahead, with blossoming coverts

along every creek and river, the very attractive red-bud (*Cercis canadensis*) brought into relief by the pale blossoms of plum and cherry. Later we rode through fields of Lupines, the justly celebrated Texas blue bonnet, carpeting the earth with its exquisite turquoise-like blossoms. These lupine fields were in Central Texas, and here spring was almost past, and I was not surprised when I reached San Benito to find that it was really summer there, and that the willows were filling the air with their small cotton covered seeds. I was only in San Benito three days, but during that time, thanks to Miss Mary Cowgill and her skillful driving, I saw several hundred miles of the surrounding "bush." We visited Point Isabel, Brownsville, and even drove across the international bridge into Matamoras, Mexico.

The "bush" about San Benito is typically desert. A characteristic form, called by the Mexicans crown of thorns (*Koeberlinia*) was covered with creamy white, star-like blossoms, very sweet scented and swarming with bees. Unfortunately, it was almost impossible to secure any of these bees, for the thorns made the use of a net impossible, and the bees were mostly too alert to be captured by hand. A common tree was called retama (*Parkinsonia aculeata*) and with its narrow leaflets and asymmetrical yellow and red blossoms looked very like some of the Japanese acacias, now so much esteemed by California gardeners. Many of the species in the "bush" had gray leaves with surprisingly large flowers. *Tillandsia* grew on the bush everywhere, and it all reminded me of Gualan, Guatemala, not even lacking the large black carpenter bees which I saw for the first time in Gualan. This "bush" seems to be the frontier of the tropics, and I was glad to find that my small collection of bees confirmed my general impression, the species of bees showing a curious mixture of northern and tropical forms.

The argemones, ænotheras, and opuntias were of especial interest. A beautiful white species of *Argemone* (*A. pinnatifida*) with rosy stamens had a most interesting variety, the petals pale pink, varying to a deep rosy purple. Only a few of these occur—in one field there were a thousand or more plants with white flowers, and only two with pink blossoms. In another place along the bank of an irregular ditch almost half of the plants bore rosy blossoms. Greene regarded this form as a different species from the white one, but when they are studied in the open there is no question but that the rosy form repre-

sents only a color variation. The argemones are easy flowers to collect from, and with the aid of Jack Cowgill, aged 6, I secured a good series of argemone-visiting bees. One day when I was away Jack used lemon extract to kill his bees, showing that even in this specialized age necessity may be the mother of invention.

The *œnotheras* were typically slightly pink, veined with rosy, but here and there a plant bore flowers of the same bright rosy color as the veins of the ordinary form. I also found white flowers in the fields with the rose-colored *œnothera*. No bees were found visiting these flowers.

The typical blossom of the *opuntia* was bright yellow, but here again there were most wonderful color varieties. The colors ranged through primrose and buffy and orange with the combinations of these colors with red, the darkest one was very lovely, a dull velvety, buffy-rose. Words give little idea of these color variations. I have seen nothing like the wonderful shades, though some of them are suggested by some of the *Auriculas*. We took a good series of bees from the *opuntias*, but none of them proved of especial interest.

LIST OF THE BEES COLLECTED.¹

Colletes intermixtus Swenk.

San Benito, one male at flower of *Koeberlinia spinosa*.

Halictus (Chloralictus) politissimus new species.

♀. Length about 5 mm., anterior wing 4 mm.; rather robust, the head broad and round, but not unusually large; head and thorax shining dark green, abdomen and legs black; mandibles obscurely reddish apically; head and thorax with short, sparse, dull white hair; face and front shining, the front finely and not very densely punctured, the punctures much smaller at the sides than in the middle; antennæ dark, the flagellum obscurely brown beneath toward end; mesothorax convex, highly polished, with scattered, weak punctures; scutellum polished; metapleura minutely cross-striate; area of metathorax with irregular longitudinal plicæ on the basal half; tegulæ dark reddish; wings hyaline, strongly iridescent, stigma and nervures very pale testaceous; hind spur of hind tibia with three or four large blunt teeth; abdomen rather thinly pruinose-pubescent; bases of segments with beautifully plumose hairs; no conspicuous punctures on abdomen. Tegulæ not punctured.

San Benito, Texas, at flowers of *Argemone* (*W. P. Cockerell*). Not unlike *H. crassiceps* Ellis, but smaller, with much smaller head.

¹ By T. D. A. Cockerell.

Halictus (Chloralictus) rhodognathus new species.

♀. Length about 6 mm., anterior wing 4.3 mm.; rather robust, head broad but ordinary; head and thorax green, the front and face, mesothorax and scutellum olive green; mandibles bright ferruginous, black at base; antennæ black, flagellum rufescent beneath toward apex; front strongly and quite closely punctured, the punctures alike from side to side; mesothorax moderately shining but not polished, with rather close, very distinct punctures all over; scutellum very finely punctured, the punctures of two sizes; area of metathorax microscopically reticulate and with wavy ridges, with an obscurely subcancellate effect; tegulæ rufotestaceous, impunctate; wings grayish hyaline, stigma and nervures rather dusky testaceous; legs black; hind spur with three long teeth; abdomen shining black, with a faint brassy luster, the apical half thinly pruinose-pubescent; punctures excessively fine.

San Benito, Texas, at flowers of *Argemone* (*W. P. Cockerell*). Resembles *H. peripunctatus* Ellis, but the wings and abdomen are quite different.

Halictus (Chloralictus) pruinosisiformis Crawford.

San Benito, many females at flowers of *Argemone*. One has the front and sides of face deep blue.

Halictus (Chloralictus) disparilis Cresson.

Point Isabel, one female at yellow composite. The abdomen is green.

Halictus (Chloralictus) coactus Cresson.

San Benito, many females at flowers of *Argemone*. The tegulæ are punctured.

Halictus capitosus Smith.

Point Isabel, one female at yellow composite.

Augochlora azteca Cockerell.

San Benito, many females at *Argemone*. This was described from Mexico, and is new to the United States. One female was taken at *Koeberlinia spinosa*.

Agapostemon texanus Cresson.

San Benito, one male at *Argemone*.

Nomia nortoni Cresson.

Point Isabel, one male at yellow composite.

Exomalopsis zexmeniae Cockerell.

Point Isabel, one female at yellow composite. Described from Guatemala; new to the United States.

Diadasia australis rinconis (Cockerell).

Point Isabel, many females at yellow composite; San Benito and between San Benito and Point Isabel, several females at flowers of cactus; San Benito, two found by Jack Cowgill on *Argemone*. Described from New Mexico.

Melissodes masuca Cockerell.

Point Isabel, six females at yellow composite; between San Benito and Point Isabel, both sexes at cactus; San Benito, male at *Parkinsonia aculeata*, female at *Phlox*. This was described from the male, and the female was unrecorded. I find I have a female, labelled "*M. galvestonensis*, variety," taken May 8 at Fedor, Texas, by Birkmann. The female runs in my tables to *galvestonensis*, except that there is a little dark hair on scutellum, easily overlooked. There is black hair on vertex. The male is quite distinct from *galvestonensis*.

Xenoglossodes wilmattæ new species.

♀. Length about 9 mm. Like *X. gutierreziae* Kll., but yellow band on clypeus much narrower, hardly broader than the apical red band; thorax above with dense, silky, reddish-ochreous hair, a broad suffused band between wings brownish; tegulae rufous, blackish on disc; marginal cell longer and more slender; apical plate of abdomen broader, rounded at end, finely transversely striate. It may also be compared with *Melissodes spissa* Cresson, but is distinguished from that by being smaller, and by the yellow band on the densely white-haired clypeus.

Point Isabel, at yellow composite (*W. P. Cockerell*).

Lithurgus apicalis littoralis new subspecies.

♂. A little over 10 mm. long; pubescence tinged with ochreous; flagellum very dark reddish beneath; abdominal hair-bands slightly ochreous; segments 2 to 5, before the bands, and 6 with pure black hair; spurs of hind legs reddish. Perhaps a distinct species.

Point Isabel, at yellow composite (*W. P. Cockerell*).

Megachile montivaga Cresson.

Point Isabel, one female at yellow composite.

Megachile parallela Smith.

Point Isabel, one female at yellow composite.

Megachile disparipennis new species.

♀. Very close to *M. perpunctata* Ckll., from Mexico, but smaller, with paler wings, and more closely and distinctly punctured abdomen. Length about 10 mm.; easily known among the species of the United States by the black cloud in marginal cell and beyond; ventral scopa pale red, basally white, a little black at end of last segment; a conspicuous tuft of white hair behind each tegula, and a dense band of white hair on postscutellum; sides of face and front with pure white hair; abdomen with narrow white hair-bands; vertex with black hair. Mesothorax dullish and very densely punctured (in one specimen there is a smooth area on disc, but this is evidently abnormal); hind basitarsi only moderately broad, their inner face with bright fox-red hair; tegulae black, with outer margin reddish; antennae entirely black.

Point Isabel, three at yellow composite (*W. P. Cockerell*).

Xylocopa tabaniformis parkinsoniae new subspecies.

♀. Differs from Smith's description of *X. tabaniformis* by hair of cheeks nearly all black; flagellum not rufotestaceous beneath; sides of thorax with black hair; apical joints of tarsi not ferruginous; tegulae pure black; light hair of abdomen cream color; first abdominal segment with black hair, a very little pallid at sides apically.

San Benito, at flowers of *Parkinsonia aculeata*.

Bombus americanorum Fabricius.

San Benito, one female. The light hair is clear yellow, as in specimens from Boulder, Colo.; not tawny as in those from New Mexico and Illinois.

The identification of the *Argemone* found at San Benito has been a matter of perplexity, but it appears that we must call it *A. pinnatifida* Norton (*A. delicatula* Small). It is distinguished by the white flowers, the filaments and stigma very dark rosy red, anthers bright orange; sepals with long bristles, the horns in bud diverging, not bristly. An occasional variety has rose-pink to very pale pink flowers; this is to be called *A. pinnatifida* f. *rosea*; Coulter described it as *A. platyceras* var. *rosea*. Rarely the petals are white with bright pink streaks. We have had these forms in cultivation, from Texas seed.

While collecting bees, Mrs. Cockerell obtained three species of Syrphid flies, as follows:

Volucella esuriens mexicana Macq.

San Benito, at flowers of *Parkinsonia aculeata*.

Volucella fasciata Macq., variety.

San Benito, at *Argemone*. This differs from a Colorado specimen as follows: Third joint of antennæ longer and more slender; mesopleura without spots; spots in front of scutellum united to form a semicircular patch, emarginate anteriorly; wing-markings darker; marks on second abdominal segment paler, their apical side oblique and inner angle more acute. It deserves a distinctive name, but probably one of the many names given to Mexican species applies.

Chrysogaster bellula Willist.

San Benito, at *Argemone*.

NEW GALL MIDGES.

BY E. P. FELT,

ALBANY, N. Y.

The species described below have come to notice recently and are published at this time in order that the names may be used in an illustrated Key to American Insect Galls now in press.

Lasioptera piriqueta new species.

A series of three or four midges were received under date of April 24, 1917, from R. H. Van Zwaluwenberg, of the Agricultural Experiment Station, Mayaguez, Porto Rico, accompanied by the statement that they were reared from *Piriqueta ovata* (Bello) Urban, Family Turneraceæ, kindly identified through the courtesy of Dr. N. L. Britton, of the New York Botanical Garden. The specimens were accompanied by labels as follows: Accession number 32-1917, III-30-1917, 2041, Mayaguez, P. R. The parasites in the vial were kindly identified through the courtesy of Dr. L. O. Howard, chief of the federal bureau of entomology, by Mr. A. R. Girault as *Necomphaloides sica* Girault.

Gall.—An irregularly oval, hollow stem enlargement, length 1-1 5/10 cm., diameter 5-7 mm. This gall may apparently be inhabited by several larvæ. The surface is more or less hairy.

Male.—Length 1.5 mm. Antennæ short, 16 segments, the fifth with 2

length about equal to its diameter, the terminal segment produced, with a length one fourth greater than its diameter and broadly rounded apically. Palpi, the first segment short, irregular; the second with a length twice its diameter; the third a little shorter than the second; and the fourth a little longer than the third. The dorsum of the abdominal segments dark brown with a medium triangular whitish area apically and oblique white lines laterally. There is also a distinct moderately narrow white band basally. Genitalia, basal clasp segment moderately long, stout; terminal clasp segment rather long, slender. Dorsal plate deeply and triangularly emarginate, the lobes narrowly rounded apically; ventral plate long, broad, broadly rounded apically. Harpes long, tapering, obtusely pointed apically. Legs dark brown, the tarsal segments narrowly annulate with white basally. Claws long, stout, strongly curved, unidentate, the pulvilli nearly as long as the claws.

Female.—Length 1.75 mm. Antennæ short, yellowish brown, 19 segments, the fifth with a length a little shorter than its diameter, the terminal segment broadly oval. Palpi, first segment irregular, the second with a length nearly three times its diameter, the third a little longer and more slender than the second, the fourth one half longer than the third. Mesonotum, scutellum and postscutellum dark brown. Abdomen mostly dark brown dorsally, the first segment possibly mostly white, the other segments apparently with a narrow white line apically. The ovipositor nearly as long as the abdomen, pale yellowish, the terminal lobes narrowly oval with a length over twice the width, and rather thickly clothed with short, stout setæ. Wings hyaline, the third vein uniting with costa at the basal half. Halteres whitish, transparent. Legs mostly dark brown, the tarsal segments possibly obscurely and narrowly banded with white.

Pupa.—Length 2 mm. Antennal cases extending to the base of the thorax, the wing cases to the third abdominal segment, and the leg cases to the fifth, sixth, and terminal abdominal segments respectively. Color, probably yellowish orange. Type, Cceid. 22810.

Janetiella siskiyou new species.

The midge described below was first reared from material received under date of January 9, 1917, from E. R. Sasscer, chief inspector of the Federal Horticultural Board, Washington, D. C., accompanied by the record: "One pound seed *Chamaecyparis lawsoniana* collected September, 1916, elevation 250 feet. Open grown, second growth trees. Section 31, T. 31 S., R. 11 W., W. 1 M., one mile north of Siskiyou National Forest, along south fork of Coquille River. H. E. Haefuer, collector of the seed." This material was recorded under Federal Horticultural Board number 20284.

An examination showed that the winged seeds were more or less deformed and inhabited by pale yellowish larvæ, which latter may be

attached in white cocoons to the sides of the seed. Only one female was reared, and the generic reference is tentative.

Larva.—Length 1.5 mm. Moderately stout, pale yellowish. Head rather short, stout, the antennæ moderately long, tapering; breastbone reddish brown, strongly chitinized, bidentate, the posterior extremity somewhat obsolescent; skin coarsely shagreened, the terminal segment of the larva slightly bilobed, the lobes broadly rounded.

Female.—Length 2.5 mm. Antennæ extending to the base of the abdomen, sparsely haired, fuscous yellowish; 17 or 18 cylindrical segments, the fifth with a length about one fourth greater than its diameter, the terminal segment produced and tapering to a narrowly rounded apex. Palpi pale yellowish, the first segment short, stout, irregular, the second minute, broadly oval, the third twice the length of the second, broadly oval, the fourth twice the length of the third and with a length more than twice its diameter (these structural details were visible on only one palpus and not very distinct). Mesonotum dark reddish brown, the submedian lines thickly black haired. Scutellum reddish brown, with two black, submedian bristles; postscutellum a little darker. Abdomen dark reddish, the dorsal sclerites somewhat darker and margined posteriorly with rather coarse black setæ. Ovipositor with a length about half that of the abdomen, short, yellowish or dark yellowish orange, the terminal lobes narrowly lanceolate, with a length about three times the width, and sparsely setose. Wings hyaline; halteres mostly yellowish transparent. Coxæ and legs a nearly uniform dark brown. Claws simple, the pulvilli about as long as the claws. Type, Cecid. a2780.

Feltiella venatoria new species.

The species described below was received under date of August 22, 1916, from Mr. D. K. McMillan, assistant to the state entomologist for northern Illinois, accompanied by the statement that the larvæ were very efficient destroyers of red spiders, *Tetranychus telarius* and other species on the leaves of elm and hollyhock, presumably at Chicago. This form is easily distinguished from earlier described American species by the markedly shorter stems of the male flagellate antennal segments.

Male.—Length 1.25 mm. Antennæ nearly as long as the body, thickly haired, mostly pale straw; 14 segments, the fifth having the stems with a length one fourth and one half greater than their diameters, respectively; terminal segment, the basal portion of the stem with a length two and one half times its diameter, the distal enlargement broadly oval. Palpi, first and second segments short, subquadrate, the third with a length about three times its diameter, the fourth a little shorter than the third and somewhat compressed. Mesonotum fuscous yellowish. Scutellum and postscutellum pale

yellowish. Abdomen and halteres mostly pale yellowish. Coxæ whitish transparent, the legs a fuscous whitish transparent; claws slender, strongly curved, the anterior and mid pair unidentate, the pulvilli about two thirds the length of the claws. Genitalia, basal clasp segment moderately stout, the basal lobe irregularly triangular; dorsal plate short, broad, deeply and narrowly incised, the lobes broad and broadly rounded; ventral plate long, broad, truncate; style long, stout, constricted near the middle.

Female.—Length 1.5 mm. Antennæ extending to the fourth abdominal segment, sparsely haired, fuscous yellowish; 14 segments, the fifth with a stem one third the length of the cylindric basal enlargement, which latter has a length about two and one half times its diameter; ovipositor short, the lobes narrowly triangular and thickly setose. Other characters practically as in the male. Type, Cecid. a2758.

MISCELLANEOUS NOTES.

Cænomyia ferruginea Scopoli.—In the Journal of this Society for June, 1917, there is a note on the distribution of this fly about New York City. All of the places mentioned are in the hill country, and no localities are given for Long Island or Staten Island. During the past summer two females of *Cænomyia* were collected to the south of Wading River, Long Island, one on June 26 at Long Pond, and another on June 27 at Deep Pond.—WM. T. DAVIS.

Cicada hieroglyphica Say.—To the south of Riverhead on Long Island there is a pine barren region resembling the pine barrens of New Jersey where during the warm days in the early part of August, 1917, I was pleased to hear the song of *Cicada hieroglyphica*. Individuals were not very common, but several were seen and examined at close range, but owing to the difficulty of collecting them in the tree-tops, none were secured. This extends the known range of the species about one hundred miles northeastward along the coast and is the first record of its occurrence in New York State. Mr. C. E. Olsen informs me that he is pretty sure he heard the song of this insect in July in pine woods a few miles to the north of Bayshore, on the south side of Long Island.—WM. T. DAVIS.

Acronycta funeralis Grote & Robinson.—A larva of this species was found on *Prunus serotina* at Washington Heights, New York City, August 13, 1917.—F. E. WATSON.

THE NEW YORK ENTOMOLOGICAL SOCIETY.

Organized June 29, 1892.—Incorporated June 7, 1893.

The meetings of the Society are held on the first and third Tuesday of each month (except June, July, August and September) at 8 P. M., in the AMERICAN MUSEUM OF NATURAL HISTORY, 77th Street and Eighth Ave.

Annual dues for Active Members, \$3.00.

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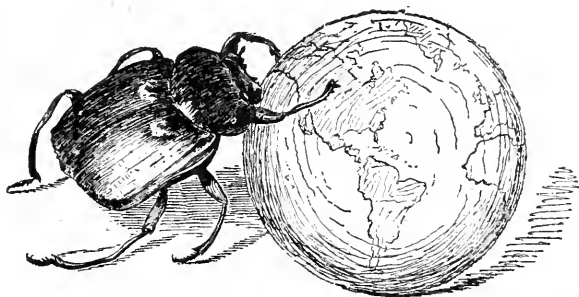
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PERMANENT FUND OF THE NEW YORK
ENTOMOLOGICAL SOCIETY.

Through the generosity of Mr. Wm. T. Davis, there has been established a permanent fund, the income of which, in accordance with the declaration printed below from the Trustee, assists in the support of the Society. Attention is called to its establishment so that members of the Society or others interested in promoting its objects, may thus have an invitation to add to its amount.

The officers especially desire to secure the permanent growth and welfare of the Society through an increase of this fund.

HARRY G. BARBER, *President*.

C. W. LENG, *Secretary*.

DECLARATION.

The Farmers' Loan and Trust Company, a corporation organized and existing under the laws of the State of New York, and having its office at number 22 William Street, in the Borough of Manhattan, City, County and State of New York, hereby declares that it has received the sum of five hundred dollars which it holds and will hold, together with any sums which may be paid to it, as hereinafter provided, as Trustee, upon the following trusts: To invest and, from time to time, to reinvest the same, including any other moneys or securities which may be, from time to time, turned over to it as Trustee hereunder, in such securities as to it may seem wise; to collect the income therefrom and to pay said income semiannually to the New York Entomological Society, a corporation organized and existing under the laws of the State of New York, for the general pur-

poses of said Society, and the receipt of the Treasurer of said Society shall be a sufficient discharge to said Trust Company for payments so made. The fund thus held by said The Farmers' Loan and Trust Company shall be known as the "Permanent Fund of the New York Entomological Society."

The said The Farmers' Loan and Trust Company, as Trustee, may pay over to said Society, from time to time, any part or parts, or the whole of the principal of the fund then held in its hands upon the receipt of a certificate by the Secretary of the said New York Entomological Society, under the seal of said corporation, to the effect that three fourths of the members of said Society have authorized such payment, over their own signatures, after the question of making such payment has been discussed at any regular meeting of the Society. The Trustee may make payment upon any such certificate being filed with it without further investigation as to the facts stated therein.

The said Trustee will receive and hold under the terms of this instrument any sums of money or securities which, from time to time, may be delivered to it by any person or persons for such purpose.

IN WITNESS WHEREOF, the said The Farmers' Loan and Trust Company has caused these presents to be signed by its President and attested by its Secretary, and its corporate seal to be hereunto affixed this first day of June, in the year one thousand nine hundred and seventeen. (Executed in duplicate.)

THE FARMERS' LOAN AND TRUST COMPANY,

SEAL.

by E. S. MARSTON,
President.

Attest: A. V. HEELY,
Secretary.

FORM OF GIFT OR BEQUEST.

I do hereby give and bequeath to Permanent Fund of the New York Entomological Society of the City of New York.....

.....
.....

THE GENUS *OPHIDERMA* FAIRM. (MEMBRACIDÆ: HOMOPTERA.)¹

BY EDMUND H. GIBSON AND EMMA WELLS,

WASHINGTON, D. C.

The genus *Ophiderma* was described by Fairmaire² to include his *salamandra*. In its distribution it is limited to North America, and includes ten species, two of which are here described as new. The genus may be characterized as follows: Pronotum greatly depressed; transversely broadly rounded; dorsal outline almost rectilinear, apex generally surpassing the tip of the abdomen; surface coarsely punctured, in most of the species pilose; without suprahumeral horns. Head short and broad. Elytra hyaline, becoming more or less smoky or brown at apex; base of corium with three contiguous nervures; four basal and two discoidal areoles; terminal areole triangular, petiolate, the adjacent contiguous before it.

Ophiderma is closely allied to several other genera, namely, *Vanduzeca* Godg., *Idioderma* Van D., and *Carynota* Fitch, but may be separated from them by having the base of the corium with three contiguous veins and the terminal areole of the wing triangular.

KEY TO THE SPECIES.

1. Dorsal line straight or a little depressed; terminal areole of the elytra triangular at base 2.
Dorsal line somewhat elevated posteriorly, but not at all compressed, behind with a slight sinus; terminal areole of elytra distinctly obtusely angled on its basal line **nigrocincta** Van D.
2. Color a uniform yellow or green 3.
Color light or dark brown or black, more or less marked with yellow .. 4.
3. Pronotum short, slender; eight black spots on face and black crescent over eye **pallida** Van D.
Larger species; pronotum long, wide; face immaculate **flava** Godg.
4. Dark brown species with distinct broad yellow band more or less straight on margin of pronotum, male with transverse apical band.
flavicephala Godg.

¹ Contributions from the U. S. Bureau of Entomology.

² Annales de la Societe Entomologique de France, 2e Serie, tome IV, p. 493, 1846.

- Greyish brown species without broad yellow band on margin of pronotum. 5.
5. Margins of cheeks not strongly sinuated; lateral margin of metopidium rounded above humerals, when viewed from front .. **pubescens** Emm.
 Margins of cheeks strongly sinuated; lateral margin of metopidium straight above humerals, when viewed from front 6.
6. Clypeus distinctly produced beyond line of face; species small.
compacta n. sp.
- Clypeus not distinctly produced beyond line of cheeks; species larger .. 7.
7. Face and metopidium bright yellow, marked with black; longitudinal and apical bands of pronotum yellow **fraterna** n. sp.
- Markings as above white 8.
8. Species large; last ventral segment of female broadly sinuate.
salamandra Fairm.
- Species smaller; last ventral segment of female not so broadly sinuate.
flaviguttula Godg.

Ophiderma salamandra Fairm.

Ophiderma salamandra Fairm., Ann. Soc. Ent. Fr., ser. 2, Vol. IV, p. 493, 1846.

This is the largest species in the genus. The female is lighter brown than male, pale markings sometimes very indistinct in female but usually very clear in male. Head is very broad which helps to distinguish it from *O. flaviguttula* Godg. Margins of the cheeks strongly sinuate. It is known to feed on *Quercus virginiana* in Texas. Its range includes the entire eastern half of the United States.

Ophiderma flaviguttula Godg.

Ophiderma flaviguttula Godg., Bull. Ill. Lab. Nat. Hist., Vol. III, p. 439, 1894.

Distinctly smaller than *salamandra* Fairm. to which it is most closely allied. The species is supposed to occur everywhere east of the Rocky Mountains.

Ophiderma pubescens Emm.

Ophiderma pubescens Emmons, Nat. Hist. N. Y. Agri. of N. Y., Vol. V, p. 157, 1854.

Generally lighter and smaller than *salamandra* Fairm. Other characters given in the key will separate this species from *salamandra*. It has practically the same distribution as the preceding species. Found on *Quercus* sp.

***Ophiderma fraterna* new species.**

Head broad, triangular, bright yellow, eyes prominent; ocelli brown, equidistant from each other and the eyes. Clypeus broad only slightly if at all produced beyond line of cheeks; longitudinal lines of clypeus brown or black; two minute points on base of vertex of head above ocelli; callosities black. Lateral margin of metopidium straight above humerals when viewed from front. Median carina smooth; pronotum densely punctate; on each side of prothorax a bright yellow band continuing from front of metopidium to two thirds length of pronotum and enclosing an oblong dark area; band becomes broader when it attains lower margin of pronotum. Apical transverse band of same color near apex of pronotum. Tegmina with large brown area at base and brown at apex, elsewhere clear. Abdomen dark brown or black, with yellow on edges of segments, tip light brown; femora, tibiae and tarsi yellow. Length 7 mm.

Described from three male specimens in collection of U. S. National Museum from Illinois, New York and Florida.

This species may be readily separated from *O. salamandra* Fairm. by the bright yellow markings on the pronotum.

***Ophiderma nigrocincta* Van D.**

Ophiderma nigrocincta Van D., Bull. Buffalo Soc. Nat. Sci., Vol. IX, p. 101, 1908.

There is one male specimen in the collection of the U. S. National Museum from Arizona which in general answers quite well the original description made from one female taken in Colorado. This specimen is marked on the pronotum with three transverse white bands, the middle one being broad and extending through elytra and abdomen. The callosities of male are the same color as face. Clypeus prominently produced. This is a small species.

***Ophiderma compacta* new species.**

Head grayish brown; clypeus broad, distinctly produced beyond line of face, longitudinal lines of brown; ocelli equidistant from each other and from eyes; two black spots on base of vertex of head; eyes brown or black; callosities black becoming rufous in older specimens. Median carina smooth; prothorax gray or grayish brown becoming lighter just beyond middle toward apex being transversed by a white band; apical half brown with white transverse apical band more distinct in male than in female. Pronotum hairy, broad extending beyond abdomen and almost to the apex of tegmina in female. Elytra brown at base and apex, elsewhere clear. Abdomen dark brown or black in male, lighter in female. Feet and legs black or brown with lighter markings. Length 5-5½ mm. Male smaller and generally darker than female.

Described from three males and three females from Arizona in the U. S. National Museum collection. One of the females is quite yellow but it is probably an older specimen.

Ophiderma flavicephala Godg.

Ophiderma flavicephala Godg., Bull. Ill. St. Lab. Nat. Hist., Vol. III, p. 439, 1894.

The broad light yellow stripe more or less straight on lower margin of pronotum extending from front angles nearly two thirds distance to the apex, separates this from all other species. The color is chestnut brown in females becoming darker in males. The pronotum of male is marked with a transverse apical band of light.

This, like most of the other species in this group has a wide distribution, occurring throughout the entire United States east of Rocky Mountains. It has been found on oak (*Quercus* sp.) and wild indigo (*Baptisia* sp.).

Ophiderma flava Godg.

Ophiderma flava Godg., Bull. Ill. St. Lab. Nat. Hist., Vol. III, p. 439, 1894.

Membracis inornata Say, Say's Ent., Vol. II, p. 378, 1824.

Ophiderma inornata Prov. Le Naturaliste Can., Vol. XX, No. 5, 1890.

Easily recognized by its green or in dried specimens, yellow color. Elytra hyaline, darker at apex. This is a stout species with broad pronotum almost attaining apex of tegmina. Clypeus short, broad, produced a little beyond line of cheeks, rounded on basal line. Face immaculate; callosities of a deeper shade of yellow.

The distribution of this species covers the entire United States east of Rocky Mountains. Oak has been recorded as its food plant.

Ophiderma pallida Van D.

Ophiderma pallida Van D., Bull. Buffalo Soc. Nat. Sci., Vol. IX, p. 101, 1908.

In this species the posterior process of pronotum is acutely narrowed at apex and little surpassing the tip of abdomen. Elytra quite large and long in comparison with rest of structure. Margins of face more or less outlined with black; pronotum a clear pale yellow; callosities and longitudinal lines of clypeus black. Species found in Arizona.

Ophiderma mus Champ.

Ophiderma mus Champ., Biol. Cent. Amer. Hom., Vol. II, pt. 1, p. 143.

This species in nature is unknown to the authors; who by original description and illustration suspicion that it either belongs to another genus or a new genus must be erected for it. However until specimens can be studied it is thought best to retain it in *Ophiderma*.

**SONORAN CICADAS COLLECTED BY HARRY H.
KNIGHT, DR. JOSEPH BEQUAERT AND OTHERS,
WITH DESCRIPTIONS OF NEW SPECIES.**

BY WM. T. DAVIS,

NEW BRIGHTON, STATEN ISLAND, N. Y.

Mr. Harry H. Knight and Dr. Joseph Bequaert were members of the Cornell University Biological Expedition, organized by Prof. J. Chester Bradley, that started by automobile from Ithaca, New York, in May, and reached California in August, 1917. Both of these gentlemen collected what cicadas they were able to find as the journey progressed, and have kindly turned them over to me. They form an interesting collection and I have been unable to identify two of them with descriptions of species mentioned in *Biologia Centrali-Americana*, or previously known from the United States. These are here described as new, together with two others from the same general region that I have from other sources. A new *Okanagana* from California is also described.

Of the fourteen species here placed in the genus *Tibicen*, only the first seven, in the opinion of the author, really belong there. In the remaining seven the uncus is wish-bone shaped instead of simple, and the first cross vein of the fore wing does not, as a rule, start as far back or near to the base of the wing from radius 3, as it does in the species having the simple uncus. The last seven species here referred to, and others of like character, will no doubt in due time be assigned to one of the genera already described, but they do not belong to the genus *Cicada*, where they would fall in Distant's arrangement by the shape of the head, for Mr. Van Duzee has pointed out in the Bulletin

of the Buffalo Society of Nat. Sciences, June, 1912, and in the Canadian Entomologist for November, 1914, that the genus as so restricted does not include any of the original Linnean species of *Cicada*.

***Tibicen pruinosa* Say.**

Wharton, Texas, June 24, 1917, male (H. H. K.).

***Tibicen marginalis* Walker (*marginata* Say).**

Wharton, Texas, June 24, 1917, male, and Victoria, Texas, June 25, 1917, male (H. H. K.).

***Tibicen superba* Fitch.**

Wharton, Texas, June 24, 1917, male; Sutherland Springs, Texas, June 26, 1917, male, and New Braunfels, Texas, June 28, 1917, female (H. H. K.).

***Tibicen montezuma* Distant.**

Comstock, Texas, July 3, 1917, male (H. H. K.).

This specimen agrees well with the figure and description in Biol. Centr.-Amer., as does a male from Gatesville, Texas, July 16, 1888, in the collection of the U. S. Nat. Museum.

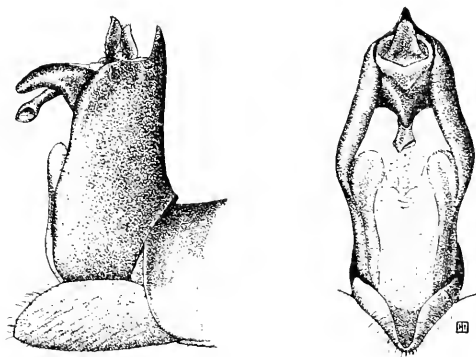
***Tibicen inauditus* new species.**

Type male from west of Vega, Oldham County, Texas, July 15, 1917 (Miss McGill). Davis collection.

A black and light orange or straw-colored species, with rather prominent eyes, and a conspicuous pruinose spot on each side of the abdomen.

Head above black with the following marks light orange-colored: a spot on the rather prominent front, a triangular one just behind this, two small ones (one larger than the other) above each antenna, and an irregular one each side of the ocelli at the back of the head. Pronotum black with the anterior margin faintly touched with light orange; the posterior margin more broadly so, the light band being about one half a millimeter in width. The anterior angles are light orange, and the tops of the raised portions, occupying the central part of the pronotum, are orange-colored and darker than the margins. Mesonotum black with a well defined pruinose stripe on each side near the base of the wings. The hind margin is light orange including the ridges of the elevated \times . The central portion is occupied by two light spots at the extremities of the \times , and anterior to the depressions there are four others, the two central spots being curved and the outer ones more rounded. Tergum black with two pruinose spots at the base, one large one each side below the tympanum, and the eighth segment also conspicuously pruinose. The posterior edge of each segment is narrowly edged with light orange.

Fore wings with the costal margins straw-colored to the end of the radial cells, beyond darkened; subcostal veins black; first and second cross veins infuscated. The basal cell of each fore wing contains a conspicuous black, longitudinal mark, with the posterior portion of the cell nearly clear. The flaps of both fore and hind wings are grayish in color. Beneath light straw-colored, with what dark margins there are about the head, nearly concealed by pruinose. The transverse rugæ are orange with the sides black and the hollows well filled with white silken hairs. There are also many hairs in the rather shallow median sulcus, and longer ones under the eyes. The legs are straw-colored, inconspicuously touched and lined with black. The opercula, straw-colored with the extremities rounded and the inner margins



Tibicen inauditus.

not overlapping. The last ventral segment slightly truncate at extremity. The valve also straw-colored. The external parts of the genitalia nearly all black.

MEASUREMENTS (IN MILLIMETERS).

	Male Type
Length of body	23
Width of head across eyes	9
Expanse of fore wings	67
Greatest width of operculum	5
Greatest length of operculum	5

In addition to the type, two other males were collected by Miss Mildred McGill during an automobile trip. She writes as follows: "They were collected close to the Ozark Trail, which leads through Glenrio, Tex., to Las Vegas, N. M. As you know it is mostly planes in this part of the country and it was in what is called the Cap Rocks which are pretty high and except for grass are barren on top. But

in the canyons there are large cottonwood and hackberry trees and grape vines. Along the rough, rugged sides of the canyon are cedars and small bushes, that are called here skunk bushes, and soap-weeds, or bear grass. It was on these small bushes and bear grass that I captured the cicadas. It was about 2.30 or 3 P. M. I located them by their singing, which was very shrill."

Tibicen species?

Black Canyon near Bumble Bee, Arizona, July 30, 1917, female (H. H. K.). I have no male with which to compare this specimen, and it is therefore doubtfully placed, but it resembles *Tibicen inauditus*, though larger.

Tibicen duryi new species.

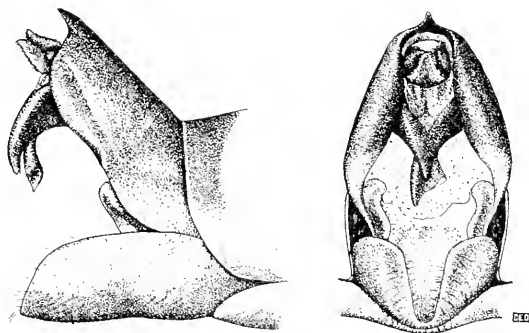
Type male, Jemez Springs, New Mexico, 7,000 ft., June 27, 1917 (John Woodgate). Davis collection.

Allotype female, Box Canyon, Grant County, June, 1912 (Charles Dury). Davis collection.

A black and reddish species much resembling an *Okanagana* in coloring, especially when the wings are closed. The head at the eyes not much broader than the front margin of the pronotum.

Head above black with the following marks deep orange in color: a spot on front, a somewhat triangularly shaped one just behind this, one above each antenna, and one irregular spot each side of the ocelli at the back of the head extending to back of the eyes. Pronotum black margined with orange, and slightly broader so on the posterior margin than on the anterior and sides. The tops of the raised portions occupying the central part of the pronotum are deep orange-colored and darker than the margins. Mesonotum black with a pruinose spot each side near the anterior margin (sometimes nearly obliterated), and a pruinose stripe each side near the base of the wings. The hind margin, the elevated portion of the X, two spots at the extremities of the X, and four spots (two inner curved) beyond the depression, orange. Tergum black with two pruinose spots at the base, one large one each side below the tympanum on the third segment, and also more or less conspicuously pruinose on the eighth segment. The posterior margins of all of the segments, except the first and second, narrowly lined with red, which is conspicuously broadened on the eighth segment of the female. The female from Fort Grant, Arizona, has a blacker dorsum, but the hind margin of the eighth segment is conspicuously red. Fore wing with the costal margin straw-colored to the end of the wing; subcostal vein black; first and second cross veins infuscated. The basal cell of each fore wing with about the outer half conspicuously blackened; more clear at base. The wings are red at base, including the flaps of both the fore and hind pair. There are

also some conspicuous black markings interspersed with the red at the base of the wings. Beneath orange, with what dark markings there are about the head nearly concealed by pruinose and silvery hairs. The transverse rugæ are black; the legs are orange conspicuously streaked with black. The



Tibicen duryi.

opercula orange, with the extremities rounded and the inner margins overlapping. The last ventral segment orange, narrowed and somewhat rounded at the extremity. The valve also orange-colored. The external parts of the genitalia nearly all black.

MEASUREMENTS (IN MILLIMETERS).

	Male Type.	Female Allotype
Length of body	28.	26.
Width of head across eyes	10.	9.5
Expanse of fore wings	73.	74.
Greatest width of fore wing	11.5	11.5
Greatest width of operculum	6.	
Greatest length of operculum	6.	

In addition to the type and allotype the following specimens have been examined:

Jemez Springs, New Mexico, July 12, 1916, 7,500 ft., female; June 15, 1917, 7,000 ft., female; July 22, 1917, 6,400 ft., male, all collected by John Woodgate. Post Creek Canyon, Fort Grant, Arizona, July 17, 1917, female (Dr. Joseph Bequaert). This last is a large specimen with wings expanding 82 millimeters. All of the above are in the author's collection.

Though this cicada resembles *Tibicen townsendi* and *Tibicen bifida*, the opercula are not as long as in either of those species, the

front is not as prominent as in *townsendi* and the genitalia differ. See illustrations in JOURNAL N. Y. ENTO. SOC., March, 1916.

Mr. Charles Dury, of Cincinnati, Ohio, who has sent me many insects, presented me with my first specimen a number of years ago, and I take pleasure in naming the species in honor of my friend.

***Tibicen castanea* Davis.**

Bonita, Arizona, Pinaleno Mts., July 16, 1917, five males (H. H. K.). Post Creek Canyon, Fort Grant, Arizona, July 17, 1917, female (J. B.).

This species was described from Arizona in the JOURNAL N. Y. ENTOMOLOGICAL SOCIETY for March, 1916, where illustrations will be found.

***Tibicen knighti* new species.**

Type male from Santa Catalina Mts., Tucson, Arizona, July 23, 1917 (Harry H. Knight). Davis collection.

Head above black with a dark yellowish spot each side between the antenna and the eye and an irregular one each side of the ocelli at the back of the head and extending to back of the eye. Pronotum blackish, shining, with the posterior marginal band olive colored, the band extending along the sides to the anterior angles, the posterior angles of the pronotum, however, are fuscous. Mesonotum shining chocolate-colored, the elevated \times olive,



Tibicen knighti.

and the sides of that color also to the base of the fore wings where there is an orange spot seen only when the insect is expanded. The outer sides of the W-mark are faintly outlined in part with olive. Tergum shining, the tympanal areas rather conspicuous and chocolate-colored. The succeeding segments blacker with the posterior margins faintly chocolate-colored. Last segment with a pruinose spot each side, and more conspicuously chocolate-colored than segments three to seven. Fore wing with the costal margin yellowish to the end of the radial cell, darker beyond; subcostal vein black;

first and second cross veins slightly infuscated. The basal cell of each fore wing nearly clear, but blackened along the anterior margin. The flaps of both fore and hind wings are gray in color. Beneath pruinose, black about the eyes, where there are some long, silken, white hairs. The transverse rugæ are yellowish and somewhat blackened where they join the shallow frontal sulcus. The legs are chocolate-colored with lighter spots and dashes, the hind pair being lighter colored than the other two pair. The opercula are pruinose, the lower extremities of the inner margins not quite touching, and the ends rounded. The ventral segments are dark chocolate-colored, central ones being lighter posteriorly. The last segment is rounded at the extremity and the valve is black. The external parts of the genitalia chocolate-colored and black.

MEASUREMENTS (IN MILLIMETERS).

	Male Type
Length of body	24.
Width of head across eyes	9.5
Expanse of fore wings	70.
Greatest width of operculum	5.
Greatest length of operculum	4.5

In addition to the type four other males were collected on rocky slopes at the same time and place. Mr. Knight says: "This form has a most unusual song; resembles loud rasping of an Acridid grasshopper; rasps and intervals about equal." This species resembles in form, in color, and in shining appearance the much smaller *Tibicen arizona* from the Santa Rita Mts., Arizona, described and figured in the JOURNAL N. Y. ENTO. SOC., March, 1916. It also resembles somewhat in form, though not in color, the figure of *Cicada psophis* in Biol. Centr.-Amer., but it does not agree with Walker's original description.

I take great pleasure in naming this insect after Mr. Harry H. Knight, who spent much time in collecting cicadas for me, as the records in this paper will attest, and who has also sent to me many other specimens on former occasions.

Tibicen delicata Osborn.

Laguna, Texas, Nueces River, July 2, 1917, on *Bignonia*, the desert willow, 5 males, 1 female, and Sheffield, Texas, Pecos River, July 4, 1917, all collected by Mr. Knight.

This species was figured on plate VI, fig. 2, JOURNAL N. Y. ENTO. SOC., March, 1916, the illustration being made from one of the type

specimens sent to me by Prof. Osborn. The seven individuals here recorded differ from this typical male, and also from the sixteen specimens in the author's collection, in having about the apical fourth of each fore wing more smoky than usual.

***Tibicen cinctifera* Uhler.**

Florence, Arizona, July 29, 1917, fifty-seven males, fourteen females (H. H. K. and J. B.); Black Canyon, Bumble Bee, Arizona, July 31, 1917, male (H. H. K.); Tempe, Arizona, August 1, 1917, four males, two females (J. B.). Grand Canyon, Arizona, Lower Bright Angel trail, August 2, 1917, three males (H. H. K.); Buckeye, Arizona, August 7, 1917, six males, twenty-one females, on poplars along irrigation ditch (H. H. K. and J. B.); Palomas, Arizona, August 8, 1917, three males (H. H. K.). Mr. Knight says of those from Florence: "On mesquite, song continuous, even toned, moderately shrill note."

The above records cover the specimens with the hind margin of the pronotum broadly banded with straw color or greenish, and the costal margin of the fore wing to the end of the radial cell also light colored. There is, however, a variety of a much darker orange color with the hind margin of the pronotum more narrowly banded with orange. For this variety we have the following records:

Del Rio, Texas, Devil's River, July 3, 1917, male; Bonita, Arizona, July 16, 1917, and Tucson, Arizona, Sabin's Canyon, Santa Catalina Mts., July 23, 1917, all collected by Mr. Knight, who states on one of the labels that "this form has a continuous song."

***Tibicen viridifascia* Walker var. *bequaerti* new variety.**

The reasons for believing that Uhler's *Cicada reperta* is a synonym of *Cicada viridifascia* Walker are given on page 58, JOURNAL N. Y. ENTO. SOC., March, 1916.

On August 10, 1916, the author collected a *Tibicen viridifascia*, and heard many more singing at Ft. Monroe, Va., the most northern locality so far known for the species. Southward from Virginia we have numerous records and specimens from along the Atlantic coast to Big Pine Key, Florida. Some of these specimens have been compared with Uhler's *reperta* in his collection in the U. S. Nat Museum, and found to be the same.

From the Gulf coast of Florida we have seen a female collected at

Carrabelle, August 9, 1903, in the collection of Prof. Albert P. Morse. In the author's collection are the following: Baldwin Co., Alabama, July 8, 1917, male collected "in a cypress on the beach by the bay" (H. P. Loding); Ship Island, Miss., August 24, 1915, female (Rehn and Hebard); Mandeville, La., June, 1916, female (H. Edw. Hubert); Timbalier Island, Terre Bonne Co., La., August 12, 1917, two males captured among the black mangroves, *Avicennia nitida* (E. C. Wurzelow). In Texas Mr. Knight collected at Richmond, June 23, 1917, five males, and at Wharton, June 24, 1917, four males. These places are about fifty miles from the coast.

The twenty-five specimens in the author's collection of Uhler's *reperta*, or *viridifascia* Walker, as we think it should be called, from the Atlantic coast, differ in markings from those from the Gulf coast, and still more so from those from Texas. The Atlantic coast specimens are darker with the venation largely orange in color, the disk of the pronotum is black with the elevated portions fulvous as described by Uhler, and the collar, or hind margin of the pronotum, is yellowish, or greenish, in some individuals. The w-mark has the lower extremities of the w quite rounded. The tergum is dark, in most of the twenty-five specimens of a chocolate color. There is the dark area in the basal cell, as described by Uhler.

The specimens from the Gulf coast so far examined are much lighter in color, the disk of the pronotum is not as conspicuously blackened especially along the front margin of the collar; the w-mark has the lower extremities of the w more pointed, and the tergum is more tawny. The nine specimens from Texas are marked like those from along the Gulf coast, the basal cell in the fore wing, however, is clear, slightly touched with black along the fore margin, and the eyes are more prominent than in specimens from the Atlantic coast. The genitalia appear to be alike in all of the specimens. Some of the features mentioned may be seen by a comparison of the figures given on the accompanying plate. We consider that the Gulf coast and especially the Texas examples, constitute a variety for which we propose the name *bequaerti*. As the type of this variety a male from Richmond, Texas, June 23, 1917, has been selected, and is shown on the plate at fig. 6. The male *viridifascia* figured, came from Beaufort, North Carolina.

Tibicen azteca Kirk. (*pallida* Distant, preoccupied).

Sutherland Springs, Texas, June 26, 1917, male (H. H. K.).

In the collection of the U. S. National Museum there are three Texas specimens that have been identified as *pallida*, and from the description of the species and figure in *Biologia Centrali-Americana*, the determination is probably correct. We figure one of the National Museum specimens. In addition to the above we can add the following records:

Wichita Falls, Texas, August 16, 1905, female (Prof. A. P. Morse); Foss, Oklahoma, July, 1916, twelve males (Miss Anna Bennett). Miss Bennett writes as follows concerning those she collected: "Found generally in the wheat and oats stubble, but some were found on trees, weeds and bushes. They sing continually, but are quite hard to locate because of their color. I believe we found most of them in the open away from the creeks and canyons."

Tibicen eugraphica Davis.

Fort Stockton, Texas, July 5, 1917, eleven males, one female (H. H. K. and J. B.); Chancellor Station, Pecos Co., Texas, July 5, 1917 (H. H. K.); Fabens, Texas, July 9, 1917, four males (J. B.), two males, two females on screw bean (H. H. K.); Mesilla Park, New Mexico, July 11, eight males, two females on edge of desert on mesquite (H. H. K.); Mesilla Park, N. Mex., July 12, five males (J. B.); Aden, N. Mex., July 12, 1917, nine males on desert (H. H. K.); Steins, N. Mex., July 14, 1917, male (J. B.); Aqua Caliente, Arizona, August 7, 1917, two males, one female (J. B.).

The following interesting record may be added to the above: Barber Co., Kansas, 1,468 ft., July 19-21, 1916, eighty males and eleven females (R. H. Beamer). Collection University of Kansas. None in this long series show any indication of green coloring. In Barber Co., *eugraphica* and what I have identified as *vitripennis* Say, occur together. Say mentions green coloring in *vitripennis*, which is true of those from Barber Co., Kans., as well as those from further north and south. *Vitripennis* is proportionally a longer-winged species. *Tibicen eugraphica* was described and figured in the JOURNAL N. Y. ENTO. SOCIETY, March, 1916.

Cacama valvata Uhler.

Comstock, Texas, July 3, 1917, male (H. H. K.).

Proarna venosa Uhler.

New Braunfels, Texas, June 27, 1917, three males (H. H. K.); Comstock, Texas, July 3, 1917, eleven males, two females (H. H. K.); Juno, Texas, July 3, 1917, four males (H. H. K.); Pecos River, Sheffield, Texas, July 4, 1917, two males (H. H. K.); Fort Stockton, Texas, July 5, 1917, one male (J. B.). Alamogordo, N. Mex., July 1, 1917, three males (Prof. Wm. M. Wheeler); Aden, N. Mex., July 12, 1917, sixty-six males and seven females "on desert grass" (H. H. K.); Steins, N. Mex., July 14, 1917, one male, one female (H. H. K.).

Pacarina signifera Walker.

Victoria, Texas, June 25, 1917, three males, two females (H. H. K.); Gillette, Texas, June 26, 1917, twenty males and two females on *Prosopis glandulosa* (H. H. K.); Sutherland Springs, Texas, June 26, 1917, four males, two females (H. H. K.); Sabine, Texas, July 1, 1917, at light (J. B.).

The specimens here recorded have been usually identified in the U. S. Nat. Museum and elsewhere, as *Pacarina signifera* Walker, but we are by no means sure that this is correct.

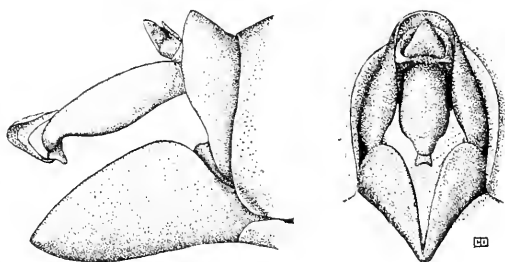
To the foregoing descriptions it may be well to add one of a new species of *Okanagana* from California.

Okanagana pallidula new species.

Type male, Athlone, Merced County, California, August 3, 1917 (Alonzo C. Davis). Wm. T. Davis collection.

A yellowish insect, almost unicolorous, with the membrane or flaps at the base of the wings orange. There are two dark spots, one on either side, on the metanotum, and there are faint indications of darker markings in some of the paratypes, but nothing constant. Some of the specimens are greenish yellow (the type is yellowish), and one shows two minute dark dots centrally near the hind margin of the pronotum; also two dark spots are included in the outlined W-mark on the mesonotum. The costal margin of the fore wings, beyond the radial cell, is also generally darkened. Beneath there is a central dark spot at the base of the abdomen, and some dark dots about the base of the legs. In structure the conspicuous feature as seen from above is the cone-like projection of the front, which is more prominent than in either *Okanagana californicus* or *Okanagana vanduzeei* which are

also more hairy beneath. The front of the head is shaped about as in *O. striatipes* from Utah, except that it is even more produced. The basal cell in the fore wing is about as long but narrower than in that species, and the eyes are less prominent. The uncus when viewed in profile is hooked at the extremity as shown in the illustration.



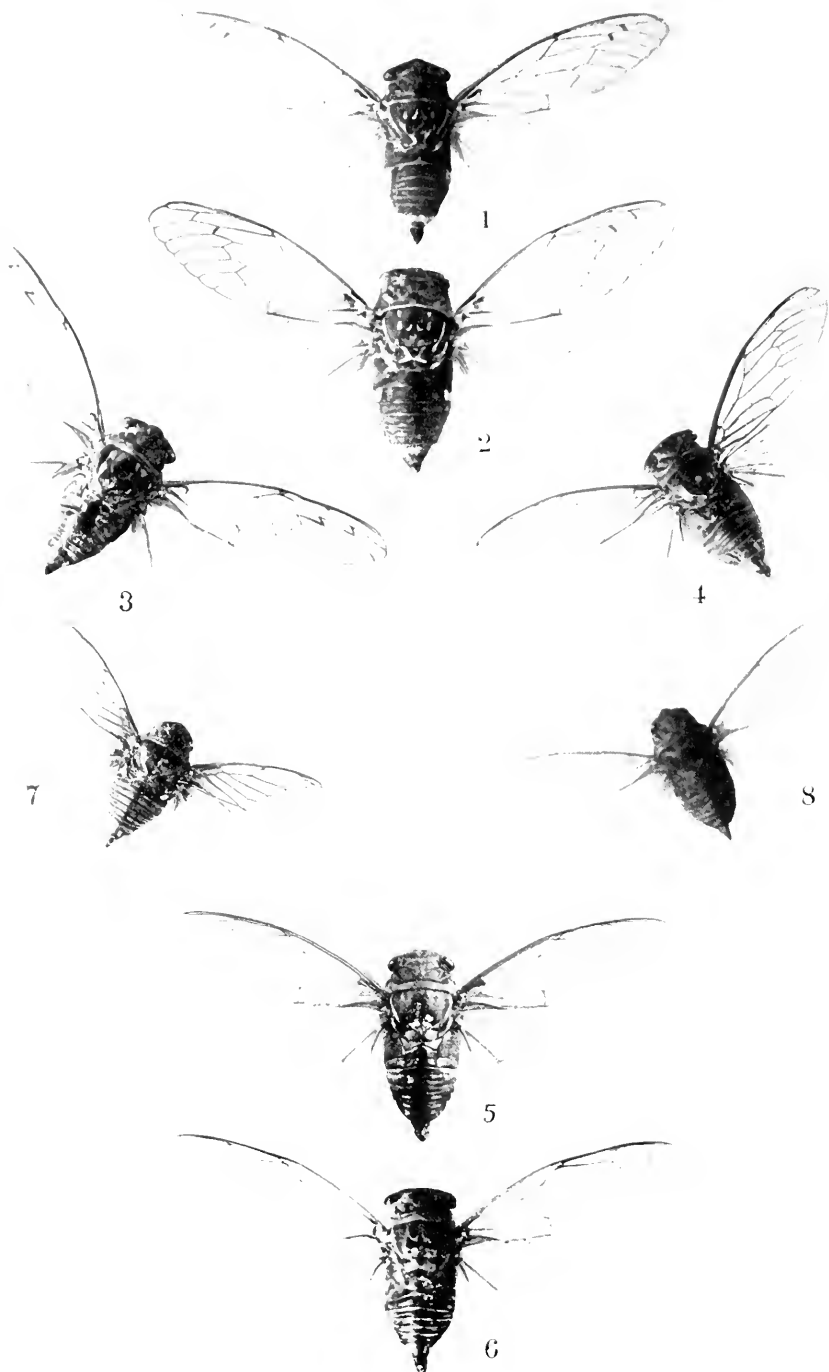
Okanagana pallidula

MEASUREMENTS (IN MILLIMETERS).

	Male Type
Length of body	19
Width of head across eyes	6
Expanse of fore wings	52
Greatest width of fore wing	8
Greatest width of operculum	3
Length of valve	3

In addition to the type the following specimens have been examined, all males and collected at Athlone, Merced County, California, in 1917 by Alonzo C. Davis, who says that they "make a *scree*" noise: July 18, one; July 19, one; July 22, two; July 23, three, one greenish individual "singing with his head out of a hole" in the ground; August 12, two.

At first sight the individuals of this species appear to be immature, but as they were captured while singing that supposition is disposed of, and further structural characters separate *pallidula* from its most closely related congeners. While *Okanagana mercedita* Davis, and the nearly related *Okanagana uncinata* Van D., have the front of about the same shape and the uncus hooked, they are much smaller and the venation is also quite different. In those species the radial cell has the front and hind margin more parallel, and the median cell is differently shaped, as may be seen by comparing the figures of



Cicadidæ.

Okanagana uncinata and *Okanagana pallidula* on the accompanying plate. *O. mercedita* was figured, JOURNAL N. Y. ENTO. SOC., Vol. XXIII, pl. 3, and through the kindness of Mr. Edw. P. Van Duzee I am now able to figure the type of his *uncinata*.

EXPLANATION OF PLATE XIII.¹

- Fig. 1. *Tibicen inauditus* Davis. Type.
Fig. 2. *Tibicen duryi* Davis. Type.
Fig. 3. *Tibicen knighti* Davis. Type.
Fig. 4. *Tibicen pallida* Distant.
Fig. 5. *Tibicen viridifascia* Walker (*reperta* Uhler).
Fig. 6. *Tibicen viridifascia* Walker var. *bequaerti* Davis.
Fig. 7. *Okanagana uncinata* Van Duzee. Type.
Fig. 8. *Okanagana pallidula* Davis. Type.

NOTES ON DRÆCULACEPHALA INSCRIPTA VAN DUZEE.

BY CHRIS E. OLSEN,

MASPETH, LONG ISLAND.

After studying the Cicadellinæ in various collections I am able to present a few points of interest concerning the faunal distribution of *Dræculacephala inscripta* Van Duzee and also to report the capture of a male specimen which, as far as is known to me, has not been reported heretofore.

This species was described by Van Duzee in Entomological News, Vol. XXVI, p. 180, April, 1915, from a single female taken in the Okefenokee Swamp, Georgia, by Prof. J. C. Bradley.

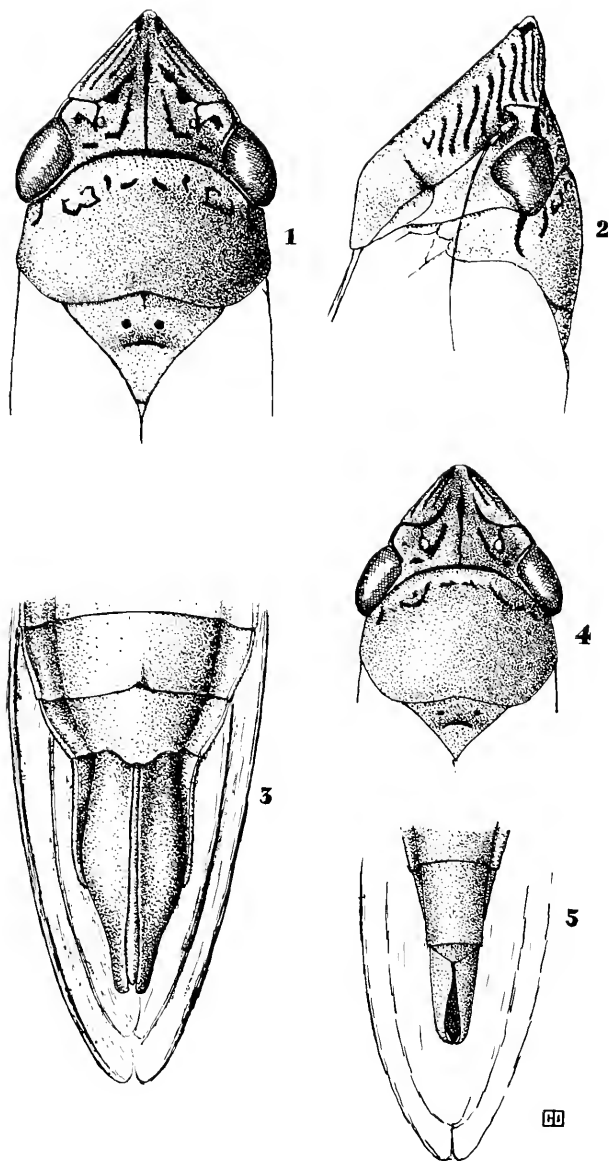
In the collection of the American Museum of Natural History I found a female specimen from Fort Lee district, N. J., on July 13, 1891 (recorded in the List of Cicadellinæ in the American Museum Coll., Museum Bulletin, in press), answering remarkably well to this description. At the time, Prof. Herbert Osborn happened to be pres-

¹ The drawings for this paper were made by Mr. Chris E. Olsen, and the photographs, from which the plate was made, by Mr. H. H. Cleaves and the author.

ent and he agreed that my identification was correct. A slight doubt still remained in my mind as to the correctness of the locality given for this specimen. The species being described and known only from Georgia, it seemed strange that this should be the only specimen to turn up in a place so thoroughly collected as the Fort Lee district, but my doubt was instantly removed when I found in Mr. William T. Davis's collection a female taken by him on Staten Island, N. Y., on September 26. These establish records for both New Jersey and New York, and there is no reason to doubt its occurrence in all the states intervening between these points and the type locality. Its occurrence south and southwest of Georgia is shown by specimens taken in Florida, Tennessee and Texas. A female in the United States National Museum was kindly sent to me for study by Mr. Edmund Gibson. This specimen came from Victoria, Texas, in September. It was labeled *Draculacephala angulifera?* Walker (identified by Ball). The fact that Dr. Ball put an interrogation mark after the determination shows that he recognized it as not being typical. The general color pattern and the vermiculate markings of anterior pronotum at once establish the difference. In Mr. William T. Davis's collection I further found two females and one male (all from Fort Myers, Florida, in April, 1912); these were taken at light. It is interesting, in this connection, that Mr. Dwight M. De Long records (Tennessee State Board of Entomology Bulletin No. 17) the capture of three females of this species in a trap light at Clarksville, Tennessee, July 14. Thus six of the specimens recorded have been taken at light; I do not know the conditions under which the others were collected. In the course of this study four females and one male have been examined. The accompanying figures were prepared to simplify the determination; Figs. 1, 2 and 3 are of a female and were drawn from the Texas specimen (U. S. National Museum collection), while 4 and 5 show a male from Florida (Wm. T. Davis's Coll.). As the specimens differ somewhat from the description of type it may be well to give further details concerning them. Quotations from the original descriptions are put in parentheses.

Female from Victoria, Texas: length 8 mm. ("7 mm."); vertex a trifle longer than one half its width across the eyes ("nearly as long"); color rather bright green ("dark dull green"); vertex, anterior margin of pronotum and scutellum, bright yellow ("dull yel-





Dræculacephala inscripta.

lowish"); median line on vertex swollen near its apex but terminating in a fine point ("slender"); scutellum with incised line and two points before it black ("three points black").

The female from the Fort Lee district, N. J., is perhaps more nearly typical, although in its length in proportion of the length of vertex to the width across the eyes and in the markings on the scutellum, it corresponds to the Texas specimen and it further differed by the face having 12 arcs instead of only 10, but its color and markings were otherwise as described by Van Duzee.

Female from Staten Island, N. Y.: in this the length of the vertex is equal to that of pronotum and just half the width across the eyes; on the scutellum it has an additional pair of black spots, triangular and protruding from under the hind margin of the pronotum; face with only 9 brown arcs.

Female from Fort Myers, Florida, is the first one in which the measurements, the proportion of length of vertex to that of the width across the eyes and the length of pronotum is typical; the color of vertex, anterior pronotum and scutellum is rather bright and clear yellow; face with only 7 brown arcs.

To sum up: All the specimens examined show a variation which is not unusual in this group. The arcs of the face, however, are subject to a rather greater variation. The green and yellow colors vary from bright to dark dull. Most striking of all is, that the two characters in which these four females all agree are not typical, namely, the length 8 mm., type is 7 mm., and two points black before the incised line on the scutellum, description mentions three points here.

As the male has been heretofore unknown it may be well to present the following description (following somewhat Van Duzee's method in describing the female):

Vertex and anterior margin of pronotum heavily marked with black. Length 6 mm.

Vertex acute, length (.76 mm.) about three fourths the length of pronotum (which measures .98 mm.); its length one half the width across the eyes (which is 1.48 mm.); surface behind the apex rather well depressed. Clypeus tumid and rather strongly angled when viewed from the side. Last ventral segment of male truncate; valve triangular and plates long, curving inwards.

Color and markings much as described for the female; the vermiculate markings on the anterior pronotum are not so clear (in this specimen); scutellum with two black dots before the black incised line; beneath, dark dirty yellowish brown, paler posteriorly; its face with nine brown arcs; the black lateral line cutting the eye is visible in front of the eye only; the apex of head is bisected by a yellowish line.

Described from one male specimen taken at Fort Myers, Florida, April 23, 1912; at light; Mr. William Davis collector. The specimen was killed shortly after moulting, but its condition is such as to warrant the above description. Allotype in the Collection of Mr. Wm. T. Davis.

IDIOCERUS SCURRA GERMAR, A POPLAR LEAFHOPPER.

BY EDGAR L. DICKERSON AND HARRY B. WEISS,*

NEW BRUNSWICK, N. J.

This species first attracted our attention during the summer of 1916 when Lombardy poplars in a nursery at Irvington, N. J., were found to be badly infested by nymphs and adults. During the summer of 1917 an opportunity was presented to study this insect. When our work was almost completed, it was brought to our notice by Mr. E. P. Van Duzee that *Idiocerus gemmisimulans* L. & C., was a synonym of *scurra* Germ., and Mr. W. H. Brittain, who has examined the types of *I. gemmisimulans* at Cornell, came to the same conclusion. *Idiocerus gemmisimulans* was treated in part by Leonard and Crosby in the Jour. Econ. Ent., Vol. 8, No. 6, p. 541, but in order to add further to the knowledge of the species, the publication of this paper was decided upon.

Idiocerus scurra Germ. appears to be well distributed in New Jersey in spite of the fact that it does not appear in Smith's "List of the Insects of New Jersey." It has been found in New Jersey on both Lombardy (*Populus nigra italica*) and Carolina poplars (*Populus*

* The arrangement of the authors' names is alphabetical only and indicates neither seniority nor precedence.

deltoides) especially Lombardy at the following places, Kingston, Irvington, New Brunswick, Red Bank, Bound Brook, Springfield, Ridgefield, Plainfield, Nutley and Rutherford and undoubtedly exists in many other places. In Van Duzee's "Check List of the Hemiptera of America, North of Mexico," its distribution is roughly given as "eastern states to Mississippi Valley and eastern Canada." Leonard and Crosby record it from Ithaca, N. Y., and Mr. Van Duzee states that it was common on poplars at Buffalo, N. Y., in October, 1912, and that as far as he knows, it was first taken in this country in October, 1909, at New Haven, Conn., by B. H. Walden.

Overwintering takes place in the egg stage, the eggs being found as a rule in the twigs, just above and concealed by the buds. They are covered only by a thin layer of bark, which becomes brown and somewhat wrinkled. Upon removing a bud, the place of oviposition is readily seen. On each side of the wrinkled, raised bark is a longitudinal crack. The bark covering the eggs is so thin that in many cases the contour of the eggs is discernible. Upon removing the thin covering of bark, the eggs can be seen arranged in a row, with the tips pointing upward and outward. Where five or six eggs were found, the row was somewhat curved. Each long, whitish egg lies flat against the adjoining one. Groups of three, four and five were common with three predominating. In several cases from nine to twelve were found in a single batch. Leonard and Crosby state that they found the eggs in groups of five to ten, eight being a common number. In some instances eggs were found irregularly laid in the twig tissue between the buds and sometimes close to but not in the tissue above the bud. At other times, eggs were found in leaf petioles and in one case in the heavy midrib of the leaf. These exceptions were more prevalent when many females had oviposited in the same twig. The eggs were always found in the last made growth of the twig or what amounts to green wood when egg deposition is under way. Every part of a young twig is utilized except the tip. Here the buds are close together, the tissue is very tender and watery and evidently unsuitable for egg deposition. In a severe infestation, from 48 to 50 eggs were found in each linear foot of twig. This is allowing sixteen buds to the foot and three eggs above each bud.

In the field hatching started about May 28 after a delay of at least a week on account of cool, unfavorable weather. In the laboratory,

the length of each nymphal stage was as follows: First, four days; second, five days; third, six days; fourth, five days; fifth, six days. This makes a total of 26 days or almost one month for all nymphal stages. In the field conditions closely approached this, thirty days being required according to field observations. After hatching, the nymphs make their way to the terminal leaves on the twigs and can be found usually on the under sides but to a certain extent on the upper. Where many are present, the upper surface of the leaf becomes characteristically whitish and discolored. Upon reaching the fourth stage, the nymphs scatter and many of them are found on the twigs resting with their heads downward. The nymphs in the later stages are very active and move rapidly when disturbed and like some other species move to the side of the twig away from the observer. This habit is also common with the adults. After emergence, the adults also scatter and can be found on all parts of the trees. Trees from 20 to 25 feet high were found to have fourth- and fifth-stage nymphs and adults on the topmost branches.

During the last few days of June adults of the first brood were quite plentiful, most of them preferring to rest on the twigs where they could be found without difficulty. By the end of the first week in July many eggs were being laid. These summer eggs required about two weeks for hatching and by August 23, seventy-five per cent. of a second brood of adults had emerged and a few overwintering eggs were being laid. Like the first brood of adults, these also scattered over the trees.

During egg deposition, the female rests parallel to the twig with her head pointing toward the top and her ovipositor inserted at right angles in the bark tissue under the bud, the tissue of the twig being torn into a slit-like opening. The operation of egg-laying also causes a similar slit to appear on the other side of the bud. Females collected June 29 and dissected showed eggs just starting to develop or partly developed and at this time, the ovaries in each female contained from 19 to 22 eggs. On July 14, when egg-laying was well under way, the number of eggs found in dissected females varied from 8 to 20. It was not possible at any time in the season to find more than 22 eggs and this probably represents the maximum number, as a number of dissections were made.

Inasmuch as the eggs are usually deposited in groups of three,

four and five, each female oviposits several times. It was noticed that the nymphs in shaded situations did not develop as rapidly as those exposed to full sunlight and for this reason and on account of the length of time over which oviposition extended, it was always possible to find a few newly emerged adults a couple of weeks after the main brood had appeared and oviposited.

On July 23, a parasite was noted ovipositing in the tissue directly over *scurra* eggs. This was kindly identified for us by Mr. J. C. Crawford through the courtesy of Dr. L. O. Howard as *Gonatocerus maga* Girault. Leonard and Crosby found the eggs being parasitized by a new species which they named *Gonatocerus ovicnatus* and which they state is very close to *G. maga* Gir. While examining overwintering eggs, a few round holes were noted in the bark overlying the egg clusters, but up to the present we have not been able to find Leonard's and Crosby's species. On one occasion an adult was observed attacked by *Podisus maculiventris* Say (Hemip.) which had its beak inserted just behind the first pair of legs while a Hemipterous nymph had its beak inserted in the extremity.

It is thus evident that in New Jersey there are two broods. Overwintering eggs hatched the latter part of May and adults appeared during the last of June. Females of this brood oviposited during the first two weeks of July and by the last week in August, adults of a second brood were plentiful. Overwintering eggs were laid chiefly during the first two weeks of September but egg-laying continued throughout the month and adults of both sexes lingered on the trees throughout the remainder of this month and during part of October. On September 13, a few first- and second-stage nymphs were noted and their presence indicated the beginning of a partial third brood. A week later however they had disappeared and no further evidence of a third brood could be found.

Descriptions of the nymphal stages can be found in Leonard's and Crosby's paper but as the nymphs vary in size, color and markings and as our descriptions are not identical with theirs, it was thought advisable to include them in this paper.

Egg.—Length 1.4 mm. Greatest width 0.35 mm. Translucent, cylindrical, slightly curved when viewed laterally; broadly rounded at basal end. Apical end obliquely truncate and acute. Cap causing truncation narrowly oval, brown in color.

First Stage Nymph.—Length 1.2 mm., width of head including eyes 0.53 mm. Antennæ about one third length of body, whitish except first and second segments which are brown. Eyes prominent, reddish, consisting of numerous distinct ommatidia. Body sparsely hairy. Head, dorsal and lateral surface of thorax, dorsal and lateral surfaces of abdomen brown. Median dorsal line beginning on head extending through thorax broadening slightly on posterior parts of thoracic segments, especially on the metathorax, where it forms a white band between thorax and abdomen. Ventral surface light except for broad median line on abdomen. Legs brown save coxa, trochanter, basal portion of femur and apical portion of tibia which are light. Rostrum white, extending to third pair of legs.

Second Stage Nymph.—Length 1.8 mm., width of head including eyes 0.8 mm. Antennæ similar to those of preceding stage, slightly darker. Eyes similar to those of preceding stage. Hairs on body more pronounced. General color similar to that of preceding stage but intensified. Broad median white stripe on dorsum of thorax more pronounced. First abdominal segment and part of second abdominal segment whitish. Small white patch in middle of third abdominal segment. Irregular whitish areas in center of abdominal segments five, six and seven (latter white patches absent in some specimens). Ventral surface like that of first stage (more pronounced in some specimens, less in others). Legs quite hairy, brown except coxa, trochanter, base of femur which are light. Rostrum extending to second pair of legs.

Third Stage Nymph.—Length 2.8 mm., width of head including eyes 1.1 mm. Antennæ about one fifth length of body. First and second segments dark brown, remainder lighter. Eyes similar to those of preceding stage. Dorsal surface dark brown, vertex of head light. Broad, median, irregular dorsal white band on thorax, extending into third abdominal segment in some specimens. Broad, whitish patch in middle of sixth abdominal segment. (Some specimens have, in addition, white patches on abdominal segments 5 and 7 and light spots on eighth abdominal segment.) Sides of meso- and metathorax extending somewhat caudad. Legs similar to those of preceding stage save articulation between femur and tibia, which is somewhat lighter. Rostrum white, extending to beyond second pair of legs. Ventral surface similar to that of first stage.

Fourth Stage Nymph.—Length 4.0 mm., width of head including eyes 1.65 mm. Antennæ and eyes similar to those of third stage. Color markings somewhat similar to those of third stage save brown of thorax which is lighter and brown of abdomen which is darker. Light markings on median dorsal surface more pronounced. Lateral posterior extensions of meso and metathorax more pronounced than in preceding stage. Legs similar to those of third stage with distal ends of tibiæ somewhat lighter. Ventral surface similar to that of preceding stage. Sexes plainly distinguishable in this stage.

Fifth Stage Nymph.—Length 5.5 mm., width of head including eyes 1.9 mm. Antennæ comparatively shorter than in preceding stage. Color and markings similar to those of preceding stage but more variable, the brown color varying from light brown to brownish black. In some specimens the dorsal surface is brown except the median portions of the metathorax and abdominal segments one, two, five and six, which are light. In other specimens the lighter markings of the dorsal surface are more extended. The posterior margins of abdominal segments seven, eight and nine bear pronounced hairs. Wing pads extending beyond anterior margin of fourth abdominal segment. Ventral surface light. Legs lighter in color, markings similar to those of preceding stage. Rostrum extending to middle of second pair of legs. Sexes plainly distinguishable in this stage.

Adult.—*Idiocerus scurra* Germ. The original description by Germar appeared in Fauna Ins. Europ., XVII, p. 11, 1834, as follows: "*Jassus scurra*: ocellis inferis, vertice lunato, pallidus, fusco-marmoratus, scutello signaturis nigris, collari transversim ruguloso, elytrorum venis fusco-maculatis, costali immaculata. Habitat in Germania."

Through the kindness of Mr. E. P. Van Duzee we are able to include the following references to *Idiocerus scurra*.

Germar, Fauna Ins. Europ., XVII, p. 11, 1834, *Jassus*.

Herrich-Schaeffer, Nomen. Ent., I, pp. 69, 112, 1835, *Bythoscopus*.
Burmeister, Genera Ins., pl. 10, 1838.

Walker, List. Homop., III, p. 859, 1851, *Bythoscopus*.

Kirschbaum, Die Gattung *Idiocerus*, p. 18, 1868.

Kirschbaum, Cicad. v. Wiesbd., p. 160, 1868.

Melichar, Cicad. Mitt. Europ., p. 151, 1896.

syn. ♀ *crenatus* Germar, Fauna Ins. Europa., XVII, p. 10, 1834,
Jassus.

Kirschbaum, Cicad. v. Wiesbd., p. 167, 1868, *Bythoscopus*.

syn. *germari* Fieber, Verh. Zool.-Bot. Ges. Wien., XVIII, p.
451, 1868.

syn. *gemmisimulans* L. & C., Jl. Econ. Ent., VIII, p. 542, pl.
30, 1915.

The species as observed by us exhibits some variation as to markings and intensity of color especially in the males. The females are lighter than the males and have their wing markings less pronounced. The majority of the second brood of females were of a decided reddish brown color. As already noted there is considerable variation in nymphal color markings but among the many which we have observed, none has been found which exactly corresponds in color markings to those illustrated by Leonard and Crosby.

It is evident that *Idiocerus scurra* is not a native American species. It was probably brought into this country from Europe, evidently in the egg stage with Lombardy poplar which was the first ornamental tree introduced into the United States. It is said that the native home of the Lombardy poplar is Afghanistan and that in early times it was cultivated in western Asia whence it was introduced into Europe. In New Jersey at least, *I. scurra* is becoming more abundant and widely distributed. In several cases it has been noted as occurring on poplars growing along city streets.

In closing we wish to express our indebtedness to Mr. E. P. Van Duzee for identifying the species and for his coöperation and help and to Mr. Andrew J. Mutchler for valuable assistance in enabling us to see the literature in the library of the American Museum of Natural History.

EXPLANATION OF PLATE XV.

Fig. 1. Twig with buds removed showing raised bark over eggs.

Fig. 2. Bark removed showing eggs in position.

Fig. 3. Egg.

Fig. 4. First stage nymph.

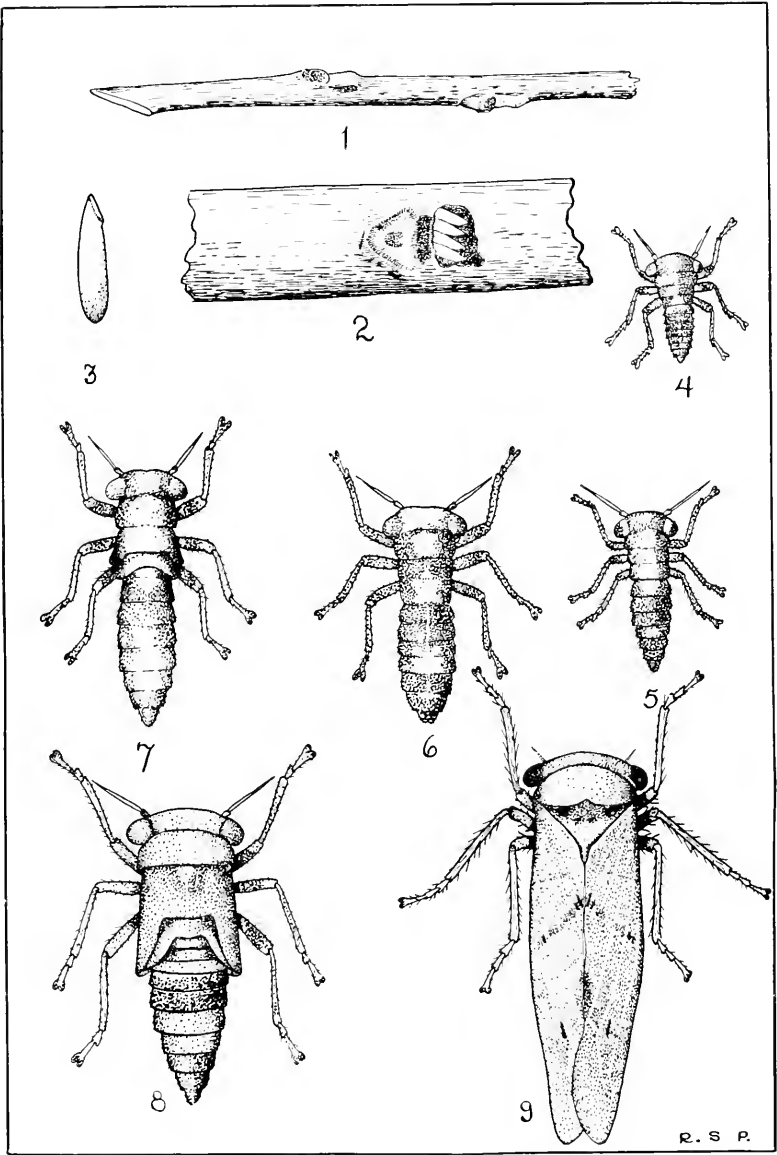
Fig. 5. Second stage nymph.

Fig. 6. Third stage nymph.

Fig. 7. Fourth stage nymph.

Fig. 8. Fifth stage nymph.

Fig. 9. Adult male, *Idiocerus scurra* Germ.



Idiocerus scurra.

A PHYLOGENETIC STUDY OF THE TERMINAL ABDOMINAL SEGMENTS AND APPENDAGES IN SOME FEMALE APTERYGOTAN AND LOWER PTERYGOTAN INSECTS.¹

BY G. C. CRAMPTON, PH.D.,

AMHERST, MASS.

In a previous paper (Crampton, 1917_b) the insects here discussed were grouped into three superorders whose principal diagnostic characters were there given. Strange to say, the neck and thoracic structures furnish far more definite characters for grouping these insects than the terminal abdominal structures of the female do; so that the following brief discussion is intended mainly to serve as the basis for a subsequent more detailed comparison of these parts in the lower orders, and also as the basis of a further study of the modifications met with in the higher insects, from the standpoint of phylogeny. For the material from which the accompanying rough sketches were made, I am indebted to the kindness of Dr. S. C. Ball, Mr. A. N. Caudell, Prof. R. A. Cooley, Mr. C. C. Gowdey, Dr. A. D. Imms, Mr. J. A. Rehn, and Dr. E. M. Walker.

Handlirsch (Die Fossilen Insekten) does not include the Apterygotan insects in the same class with the Pterygotan forms, but, when one makes a careful comparison of the various anatomical structures in the two groups, the fundamental resemblances point to a very close relationship between the Apterygota and lower Pterygota. Indeed, the differences between the lower Pterygota and the higher Pterygota (aside from the presence of wings) is infinitely greater than between the Lepismoid representatives of the Apterygota, and the lower Pterygotan insects. The striking similarity between the head of a Lepismid and that of a nymphal Plecopteron has already been pointed out,² and the similarity between the terminal abdominal segments of a Lepismid and those of a lower Pterygotan insect is no less fundamental. Thus the suranal plate labeled "11" in fig. 8, of a lower

¹ Contribution from the Entomological Laboratory of the Massachusetts Agricultural College, Amherst, Mass.

² Ent. News, for November, p. 398.

Pterygotan insect, is represented by a similar suranal plate in the Lepismids (fig. 2, "11"); although this plate in the Lepismids bears a terminal abdominal filament (fig. 2, *t*) not present in most Pterygotan insects, excepting the Ephemerids. The cercus-bearing podical plate of the lower Pterygotan insects (labeled "*p*" in figs. 8, 12, 6, etc.) which is apparently a portion of the eleventh segment, is also present in the Lepismids (fig. 2, "*p*"; the attachment of the cercus is indicated by the letter "*c*"). The tenth segment, designated by the numeral "10" in figs. 8, 12, and 4, is only slightly less pointed and projecting in the Pterygota there figured, than in the Lepismid depicted in fig. 2. The ninth segment is divided into a dorsal and a ventral portion 9s and 9t in the Pterygotan insect shown in fig. 8, and the same is true of the Lepismid (fig. 2); but in the Lepismid, a large stylus, or "megastylus" (fig. 2, "*m*"), is borne on the ventral plate of the ninth segment of the female, while in the majority of the lower Pterygota (with the exception of the Odonata) such a stylus is retained only on the tenth segment of the male. The dorsal valve of the ovipositor (fig. 5, "*d*") is borne on the ninth segment, and the ventral valve (fig. 5, "*v*") is borne on the eighth segment in the lower Pterygota, as in the case in the Lepismids³ also (fig. 2, "*d*" and "*v*"). It is thus clearly evident that the terminal abdominal structures of the Lepismids are fundamentally and essentially similar to those of the lower Pterygotan insects, and the same is true of the head and other structures, so that Handlirsch's attempt to separate the Apterygota into a class or classes which do not include the Pterygota also, is quite unwarranted, and fails to take into consideration the fundamental resemblances which underlie all true relationships.

The terminal abdominal structures described above, remain but little modified in the lower Pterygotan insects, and it is rather surprising that they do not give more serviceable clues as to the relationships of the insects here discussed. They do however furnish some indications of relationships which are borne out by the study of other structures, and this would doubtless be even more evident if other more favorable material were available for comparison.

General usage requires that designations of a Latin or Greek derivation shall be applied in anatomical terminology, so that the

³ This statement is based on figures of Lepismids by other investigators since I am not sure of the sex of the Lepismid here figured.

English designations "suranal plate" and "podical plate" are hardly suitable for universal application. In the following discussion the designation suranal plate has therefore been changed to the briefer term *pygidium*, and for the designation podical plate, the briefer term *subcercus* has been substituted, since the plate in question always bears the cercus, as the latter name implies.

The superorder Panplecoptera (composed of the Plecoptera, Dermaptera, Hemimerus and the Embiids) is typically an ovipositorless group, although certain earwigs, such as the one shown in fig. 9, have an ovipositor. In most members of this group, the eighth abdominal sternum does not overlap the following segment; but in certain Plecoptera there is a well-marked projection of the posterior margin of the eighth abdominal sternum extending backward over the succeeding sternum, and in many earwigs (fig. 9) the eighth abdominal sternum overlaps the following segment ventrally to a considerable extent. The tenth abdominal segment is relatively quite large in this superorder, and in most Dermaptera, Plecoptera and Embiids the pygidium ("11" of figs. 8 and 11) projects downward from the end of the tenth segment; although in the earwig shown in fig. 9, the pygidium (labeled "11" in the figure) projects backward and is curved in contour, somewhat like that of the Phasmid *Timema*⁴ (Fig. 12, "11"). The cerci of some immature Plecoptera (fig. 4, c) have small ring-like segments similar to those of the cerci of Lepismids, while other Plecoptera (fig. 11) have cerci composed of cylindrical segments. In certain of the smaller Plecoptera, the number of segments in the cerci is reduced to only two, so that the difference in the cerci of the members of this superorder is not as great as would at first seem to be the case, and indeed, certain Dermaptera, such as *Diplatys* (or *Dyscritina*), in the immature stages have retained segmented cerci very like those of the Plecoptera.

The superorder Panorthoptera (composed of the Orthopteroid, Phasmoid, and Grylloblattoid insects) is typically an ovipositor-bearing one, and in this group, the ovipositor reaches its greatest development (in the lower Pterygotan insects), being usually composed of three valves (fig. 12, etc., *d*, *i*, and *v*), two of which are borne on the ninth segment, while the ventral one is borne on the

⁴ An examination of subsequently received material would indicate that the curved contour is due to being crushed.

eighth segment. In the Phasmid *Timema*, the dorsal and ventral valves of the ovipositor (fig. 12, "d" and "v") have a more or less clearly demarked basal "segment" ("b" of fig. 12) and resemble those of the more primitive Blattids (fig. 5) in this respect. Traces of this basal portion of the valvæ occur in many other forms as well (figs. 7, 6, etc.), and in certain of the Orthoptera (fig. 10) a more or less vertical basal sclerite labeled "f" also occurs. In the Orthopteron shown in fig. 10, this sclerite articulates with a narrow "lora"-like sclerite labeled "l" which furnishes a firmer support for the movements of the ovipositor than the membranous region through which it extends, would give. In the more primitive Phasmids (fig. 12) the posterior region "s" of the eighth ventral segment does not project posteriorly to any great extent, as is true of many other representatives of this superorder. In certain Phasmids, however, this portion of the eighth ventral segment projects backward for a considerable distance and forms a sheath for the ovipositor, thus resembling quite closely the condition found in the Mantids (although this portion of the eighth segment is not shown in the Mantid depicted in fig. 7). The tenth abdominal segment is moderately well developed in this group, and the so-called suranal plate ("11" of figs. 6, 10, and 12) projects backward, instead of downward as in the preceding group. The region in question certainly appears more like merely a demarked portion of the tenth segment; but provisionally, at least, the generally accepted interpretation of it as the suranal plate (or suranale) has been adopted in the present paper. The cerci are usually one-segmented in this group, but in *Grylloblatta* (fig. 1), they are composed of cylindrical segments similar to those of certain Plecoptera (fig. 11). The pericercal organs occurring in rings about the segments of the cerci of the Grylloblattids (fig. 1, "o") are apparently sense organs, and their arrangement is quite different from the usual one, in this respect. The cerci of such Gryllids as *Æcanthus* (fig. 10, "c"), although but one-segmented, are longer than the ovipositor, and suggest a rather close relationship to *Grylloblatta* (fig. 1).

The superorder Pandictyoptera (composed of the Isopterous, Blattoid, and Mantoid insects) was possibly originally an ovipositor-bearing one, although many of the roaches have lost the ovipositor, and the Isoptera probably never developed one. Although it is not shown in the accompanying figures, the ventral portion of the ter-

minal abdominal segments (and frequently the dorsal portion also) is typically overlapped by a backward prolongation of the eighth segment. Holmgren, 1909 (p. 150), states that the *seventh* abdominal segment partially overlaps the following ones in the termites, and in his fig. 73 he designates this overlapping segment as the seventh. I think, however, that he has mistaken the actual *eighth* segment for the "seventh," due to the fact that the first abdominal segment is not developed ventrally, in the termites. The tenth segment is moderately well developed tergally, but there is a tendency for the suranale to become rudimentary, especially in the Blattids. When the pygidium is developed (figs. 7 and 13) is usually projects downward, instead of backward as in the Panorthoptera. The cerci vary in form and in the number of segments composing them, but frequently the basal segments are more annular in outline in this group. The number of segments in the cerci may be reduced to one in this superorder also (fig. 5), thus showing that the tendency toward the reduction of the number of segments is quite widespread in all of the insects here discussed, making it practically impossible to make any general statements as to the number and character of the segments of the cerci in the different groups.

The Panplecoptera have apparently departed as little as any from the ancestral condition of the lower Pterygota, and it is rather remarkable that few if any of them seem to have retained any styli, since the Lepismids and other related Apterygotan insects are provided with numerous styli (fig. 2, "*st*" and "*m*"), and these structures occur in the males of the other two groups here discussed. The lack of an ovipositor in many representatives of the Panplecoptera is another feature which might appear to argue against the primitive character of this group, since a well-developed ovipositor occurs in many Lepismids, and other related Apterygota. The very primitive Apterygotan insects *Campodea* and *Anajapyx*, however, have no ovipositor, and the most primitive of all insects, the Protura, have no styli either, so that the absence of ovipositor and styli in the Plecoptera, etc., may be regarded as a retention of a primitive condition, rather than as a condition brought about by the loss of these structures. Furthermore, the development of the tenth abdominal segment ventrally, and the ring-like character of the ninth segment in the Plecoptera (figs. 4 and 11) seem to be primitive characters, since

a similar condition occurs in the lowest Apterygota (*Campodea*, *Eosentomon*, etc.). Although both types of cerci occur in the Panplecoptera, I am inclined to regard those with numerous small ring-like segments (fig. 4, "c") as the more primitive. The fact that the eighth abdominal sternum does not overlap the following ones is another primitive feature in the Plecoptera, and, on the whole, the Plecoptera seem to have departed as little as any living insects, from the original condition of the ancestors of the Pterygota. In many respects they are fully as primitive as the lowest fossil Pterygota, and a study of their structures is equally important from the standpoint of phylogeny. Furthermore, in dealing with living forms, there is the added advantage of being able to examine numerous details not preserved in fossil specimens, and to take into account the various biological data as well!

Before discussing the interrelationships of the three superorders here mentioned, their principal diagnostic characters may be briefly summarized in the following table. There are some exceptions to the general application of these characters, but, in the main, they hold good for the groups in question.

	Pandictyoptera (Usually)	Panorthoptera (Usually)	Panplecoptera (Usually)
Head	Opisthognathous (except Isoptera)	Hypognathous	Prognathous
Lateral cervicals....	Corners touch in mid-ventral line	Do not touch	Do not touch
Ventral cervicals...	Narrow transverse bands situated far forward	Usually none	Broader plates situ- ated nearer prosternum
Posterior tergal wing process.....	Well developed	Usually not well de- veloped	Absent or reduced
Meso-scutellum....	Narrow, extending far forward	Not extending far forward	Not extending far forward
Meso-postscutellum	Reduced or wanting	Absent	Well developed (except ear- wigs)
Meso-coxae (from mesal surface)...	Longer than broad	Short (except Gryl- loblattids)	Short
Tarsi.....	Pentamerous (re- duced in some Iso- ptera)	Pentamerous to trimerous	Trimerous
Ovipositor.....	Developed in some (except Isoptera)	Well developed (ex- cept Gryllotal- pids)	Absent (except earwigs)
Styli of male.....	Retained in some	Retained in some	Absent

Some of the representatives of each superorder have retained characters common to certain other superorders, and may therefore be spoken of as annectent between these groups. Thus, the Mantids and Isoptera resemble the Grylloblattids and Phasmids in some respects, while in others, they resemble the Embiids and Dermaptera. Similarly, the Grylloblattids and Phasmids resemble the Mantids and the Isoptera as well as the Embiids and Dermaptera: and, in the same way, the Embiids and Dermaptera resemble the Mantids and Isoptera as well as the Grylloblattids and Phasmids. Of these annectent forms, the most important are the Mantids, Grylloblattids and Embiids.

The older method of representing the relationships of the orders of insects by means of a dichotomously branching tree, drawn in one plane, is very unsatisfactory, since it does not allow for the fact that several lines of descent may approach one another from different directions (*i. e.*, the branches of the tree should be represented in *three* planes) and that one group of insects may be intermediate between two other groups, being hardly more closely related to one than to the other. If the relationships of the three superorders here discussed were to be represented graphically, it would be more exact to represent these superorders as forming the three apices of a triangle, each apex of which is connected with the other two by mutual bonds of relationship—or better yet, to represent them as three overlapping circles, each of which intersects the other two, and all having a certain amount of territory in common, although each circle forms a distinctly demarked group, when considered separately. In this area common to the three circles, the Embiids, Grylloblattids and Mantids would be placed, since these three members of the different superorders have a surprisingly large number of features in common, and are the most important “annectant” insects of the groups under discussion. Of slightly less phylogenetic importance are the Dermaptera, Phasmids and Isoptera, although they too furnish many valuable clues as to the relationships of the groups, so that if the interrelationships of the three superorders were expressed briefly in a formula, the annectent insects of less importance would be placed in parentheses as follows. “Mantids (Isoptera)—Grylloblattids (Phasmids)—Embiids (Dermaptera).”

In opposition to Dr. Walker's view as to the close relationship of

the Grylloblattids to the Blattids, I previously emphasized the remarkable structural resemblance between the Grylloblattids and Embiids in respect to their antennal segments, their cervical sclerites, the dorsal and pleural regions of their thoraces, etc. A study of the terminal abdominal segments and their appendages, however, would indicate that there is much to be said in favor of Walker's view, provided that instead of the Blattids, we consider the *Mantids* (which are very closely related to the Blattids). Thus, the terminal abdominal segments of the Grylloblattids (fig. 1) are very similar to those of the Mantids (fig. 7) in outline, and the same is true of their appendages, the ovipositor and cerci, while the Embiids have no ovipositor, and their cerci are composed of but two segments. In this connection, however, it should be remembered that even within the same order, some members of the group have no ovipositor while others have a well-developed one (*c. g.*, the Gryllids have a well-developed ovipositor, while the Gryllotalpids have none), and some Plecoptera have cerci composed of many segments, while other Plecoptera have cerci composed of but two segments. On the other hand, the cervical sclerites, and the thoracic sclerites remain remarkably constant or unmodified within an order and are therefore of greater importance from the standpoint of phylogeny! Furthermore, some members of the superorder Panplecoptera (notably the Dermaptera) have an ovipositor, and the segments of the cerci of other Panplecoptera are very similar in outline to those of the Grylloblattids, as may be seen by comparing fig. 11 with fig. 1; so that taking the Panplecoptera as a whole, the Grylloblattids are structurally slightly nearer to them than to the Pandictyptera, to which the Mantids belong. I would not minimize the remarkably strong resemblance between the Grylloblattids and Mantids, however, and would consider the Grylloblattids as structurally intermediate between the Mantids and Embiids; but their line of development parallels that of the Embiids somewhat more closely than it does that of the Mantids, so far as the least-varying structures are concerned.

Within the superorder Panorthoptera, the Grylloblattids are apparently nearer to the Gryllid-"Locustid" group, while the Phasmids are somewhat nearer to the "Acridids." In the superorder Panplecoptera, the Embiids are much closer to the Plecoptera, while the Dermaptera and Hemimerids are extremely closely related. In the

Pandictyoptera, the Mantids are somewhat closer to the Blattids than the Isoptera are, and the Isoptera are much nearer the Blattids than they are to the Mantids. The Psocids, which are placed near the Isoptera by Handlirsch (and are grouped with the Isoptera and Embiids by Enderlein) are in reality extremely closely related to the *Neuroptera* instead, and have departed but little from the ancestral condition of the Homoptera. The relationships here expressed are based upon a study of structures located in widely different parts of the body, and the agreement in a great number of details precludes the possibility of being deceived by a mere "convergence" or parallelism of development due to a similar mode of life, or other causes! It is necessary, however, first to take up each region of the body in a series of comparative studies of the most important structures, giving especial weight to those which vary but little within an order; and until this is done we have no really firm basis for determining the ancestry and interrelationships of the lower orders, for "one man's opinion is as good as another's" in such matters, and it is only by citing the facts of the case, and supporting one's statements by drawings of the parts in question, that one's opinions concerning the relationships of the orders of insects can carry any weight. On this account, it is preferable to defer the summing up of the numerous structural resemblances upon which the relationships here proposed are based, until the series of comparative anatomical studies (of which the present paper, and the one dealing with the lateral head, neck, and prothoracic regions, are a part) is more nearly completed, and the figures of the parts in question are available for reference in the discussion, since it would make too bulky and expensive a paper to attempt to publish all of these figures in a single article.

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ABBREVIATIONS.

- b*, basal sclerite of valve of ovipositor (Basivalvula).
- s*, cercus.
- d*, dorsal valvula of ovipositor (Survalvula).
- f*, basal sclerite of valvula of ovipositor (Valvifer).
- i*, intermediate valvula of ovipositor (Intervallvula) serving as egg-guide.
- l*, lora of ovipositor (Valvilora).
- m*, large stylus (Megastylus), usually only one retained in Pterygota.
- o*, pericercal (sense) organs.
- p*, podical plate (Subcercus), or cercus-bearing plate, a portion of the 11th segment.
- s*, subgenital plate (Subgenitale).
- st*, stylus.
- t*, terminal filament.
- v*, ventral valve of ovipositor (Subvalvula).

Numerals denote the number of the abdominal segment in question, the letter "*t*" written above the numeral denotes the tergum of that segment, and the letter "*s*" denotes the sternum. The numeral "11" denotes the suranal plate (Pygidium).

EXPLANATION OF PLATES XVI AND XVII.

(All figures are of females.)

Fig. 1. Terminal abdominal structures of *Grylloblatta*; lateral view of sinistral half of the body, showing 6th to the 11th segments.

Fig. 2. Terminal structures of a Lepismid; cerci removed and terminal filament partially cut off. Position of cercus indicated by letter "*c*."

Fig. 3. Segments 6 to 10 of the Phasmid *Ectatosoma*.

Fig. 4. Terminal structures of an immature Plecopteran *Pteronarcys*.

Fig. 5. Terminal structures of a "Blattid," *Dasyposoma*. The overlapping portions of the preceding segments have been removed.

Fig. 6. Terminal structures of the Orthopteran *Paranabrus* (a "Locustid"). Ovipositor partially removed.

Fig. 7. Terminal structures of the "Mantid" *Stagmomantis* (?). Overlapping ventral portion of 8th segment removed, the point of attachment being indicated by black area.

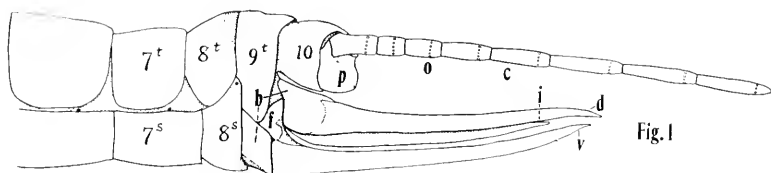


Fig. 1

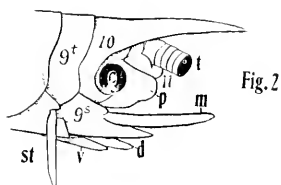


Fig. 2

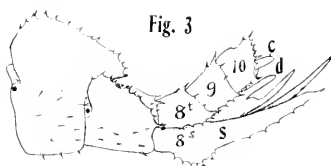


Fig. 3

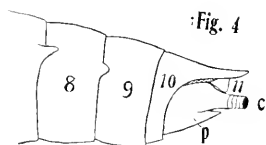


Fig. 4

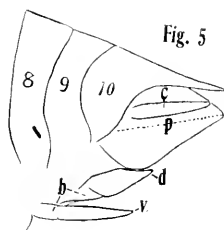


Fig. 5

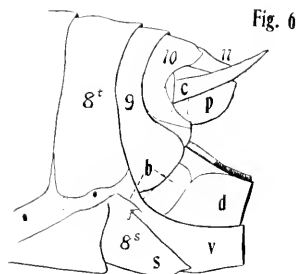


Fig. 6

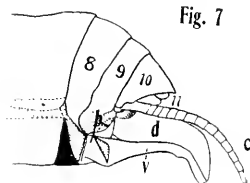
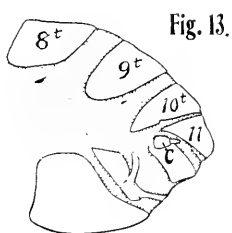
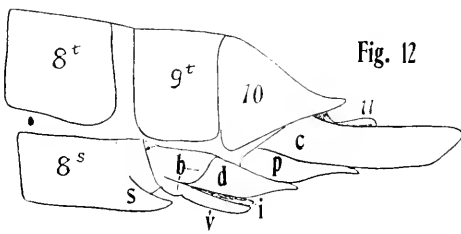
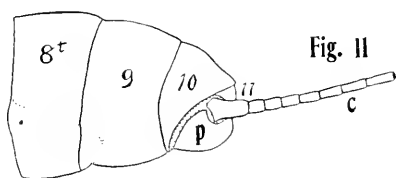
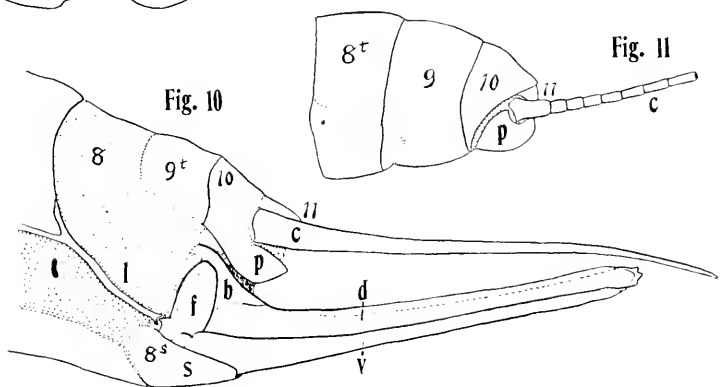
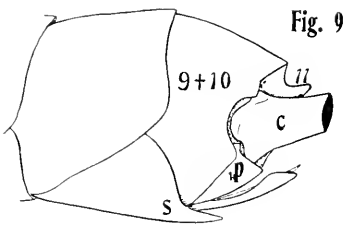
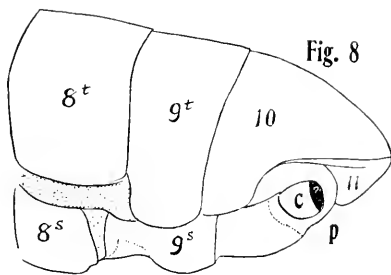


Fig. 7

Apterygota and Pterygota.



Apterygota and Pterygota.



Charles Palm.

Fig. 8. Terminal structures of *Embia major* (cerci partially removed).

Fig. 9. Terminal structures of *Echinosoma* (an earwig) forceps partially cut off.

Fig. 10. Terminal structures of the "Gryllid" *Æcanthus*.

Fig. 11. Terminal structures of the Plecopteron *Capnia* (terminal segments of cercus not drawn).

Fig. 12. Terminal structures of the Phasmid *Timema*.

Fig. 13. Terminal structures of *Termes*.



CHARLES PALM.

Charles Palm, one of the founders of the New York Entomological Society, died November 5, 1917. He was born at Calbe, on the river Milde, in Germany, in 1836, and was therefore in his eighty-second year. He came to the United States in 1854 and had a successful commercial career, founding the firm Palm, Fechteler & Co., which introduced the decalcomania industry in this country. His home was long at No. 172 East 64th St., where his great collections of lepidoptera and coleoptera were, and where he entertained many of the entomologists like Dietz, Merkel, Luetgens, who have died years ago, as well as those of the present generation. In the early days of the New York Entomological Society, Mr. Palm, then already approaching sixty, was very active in promoting its welfare. He served it for more than ten years on the Executive and Publication Committees, was vice-president for four years and president in 1897. The social features of the meetings were always of interest to him and his connection with the Arion Society aided him in promoting them. Unfortunately his advancing years eventually made evening meetings impossible and he resigned his membership in February, 1916, when he was eighty years of age.

He distributed the Arizona beetles collected by Dr. R. E. Kunze for many years and became thereby known to many in connection with *Plusiotis gloriosa* and other Arizona rarities.

The prominent part he took in entomology is commemorated by the species and genera that have been named in his honor, viz.:

Mcmythrur palmi, Hy. Edwards, 1887.

Datana palmi, Beutenmuller, 1890.

Paranthrene palmi, Neumogen, 1891.

Palmia, Beutenmuller, a genus of Sesiidæ, 1896.

Clerus palmi, Schaeffer, 1904.

Rhynchites palmi, Schaeffer, 1905.

Pterostichus palmi, Schaeffer, 1910.

We know that many of our readers, men like Charles Dury, H. W. Wenzel, and others who were among Mr. Palm's oldest friends, will join in the regrets that were expressed at the Society meeting over the passing away, in the fullness of years, of one more of that group of New York entomologists who did so much during the latter part of the last century, by accumulating and distributing large collections to promote the study of entomology.

WILLIAM DUNHAM KEARFOTT.

Wm. D. Kearfott, a member of the New York Entomological Society since 1898 and its vice-president in 1901 and 1902, died November 12, 1917, at his home in Montclair, from an attack of apoplexy, in his fifty-third year. Mr. Kearfott was born in Berkeley Co., W. Va., January 12, 1864, and was educated in the public schools. He was a mechanical engineer, connected successively with the Morton Pool Co., the International Navigation Co., the Worthington Steam Pump Co., the Warren Steam Pump Co. and Kearfott Engineering Co. In entomology he was interested in the micro-lepidoptera of the world, especially the Tortricidæ, amassing an important collection of specimens and drawings of foreign types, much of which is now in the American Museum of Natural History.

WRITINGS OF W. D. KEARFOTT.¹

A revision of the North American species of the genus *Choreutis*. Journ. N. Y. Ent. Soc., X, 1902, pp. 106-126.

Notes on a Eriocranid Larva. Ent. News, XIII, 1902, pp. 129-132.

Descriptions of new Tineoidea. JOURN. N. Y. ENT. SOC., XI, 1903, pp. 145-165.

New Tortricids from Kaslo, B. C., and the Northwest. Can. Ent., XXXVI, 1904, pp. 109-114, 137-141.

A new Proteopteryx. T. c., pp. 306-308.

Colcophora tiliaefolliella Clem. T. c., p. 324.

¹ Compiled by Frank E. Watson.

Microlepidoptera—Suggestions. Ent. News, XV, 1904, pp. 89-96, 127-136, 165-169, 207-212.

The Microlepidoptera in Holland's Moth Book. T. c., XV, 1904, pp. 104-105.

Notes on the Life-history of *Polychrysis formosa* Gr. T. c., XV, 1904, pp. 301-302.

Tutt's British Lepidoptera. T. c., XV, 1904, p. 312.

North American Tortricidæ. Trans. Amer. Ent. Soc., XXX, 1905, pp. 287-299.

Descriptions of new species of Tortricid Moths from North Carolina, with notes. Proc. U. S. N. M., XXVIII, 1905, No. 1398, pp. 349-364.

Assiniboia Microlepidoptera, collected by Mr. T. N. Willing. Can. Ent., XXXVII, 1905, pp. 41-48, 89-93, 119-125.

Hemerophila kincaidiclla Busek. T. c., p. 188.

Manitoba Microlepidoptera. T. c., pp. 205-209, 253-256, 293-296.

New Tortricids. T. c., pp. 9-11.

A new Gelechiid from Ontario. T. c., p. 15.

Desmia funeralis Hbn. Can. Ent., XXXVII, 1905, p. 238.

New North American Tortricidæ. Trans. Amer. Ent. Soc., 1907, XXXIII, 1907, pp. 1-98.

Microlepidoptera from the Black Mountain region of North Carolina, with descriptions of new species. Bull. Amer. Mus. Nat. Hist., XXIII, 1907, pp. 153-167.

New Microlepidoptera. Can. Ent., XXXIX, 1907, pp. 1-8, 53-60, 77-84, 121-128, 153, 160, 211-212.

New North American Tortricidæ and Tineina. Journ. N. Y. Ent. Soc., XVI, 1908, pp. 167-188.

Descriptions of new species of North American Crambid Moths. Proc. U. S. N. M., No. 1640, XXXV, 1908, pp. 367-393.

Fernalds' Genera of the Tortricidæ. Can. Ent., XL, 1908, pp. 334-336.

Synonymy of certain Tortricidæ. Ent. News, XX, 1909, pp. 52-57.

A new species of Japanese Microlepidoptera. Can. Ent., XLII, 1910, pp. 346-347.

Three new Brazilian Microlepidoptera. Ent. News, XXII, 1911, pp. 125-127.

PROCEEDINGS OF THE NEW YORK
ENTOMOLOGICAL SOCIETY.

MEETING OF MAY 15.

A regular meeting of the New York Entomological Society was held at 8:15 P. M., May 15, 1917, in the American Museum of Natural History; President Harry G. Barber in the chair, with 21 members and two visitors, including Mr. Oscar Fulda, present.

In the absence of the Outing Committee Dr. Lutz proposed a one-day trip to Bear Swamp for Decoration Day in which several members engaged to take part.

Dr. Alvah Peterson, of Rutgers College, New Brunswick, N. J., was elected an active member.

Mr. Davis read a letter from Farmers' Loan & Trust Co., in reference to a permanent fund to which he had offered to give \$500 and asked the Society's acceptance of the gift, subject to the conditions suggested, after the same had been approved by a committee of which he suggested Mr. Woodruff, on account of his legal training, should be a member.

Mr. Dow moved that the President appoint a committee of three with power to approve the conditions and accept the gift.

The motion being unanimously carried, the President appointed as such a committee Messrs. Davis, Dow and Woodruff.

The Secretary read a communication from the Dept. of Agriculture by title.

Mr. Olsen read a paper on "Cicadellidæ in American Museum Collection" illustrated by specimens in which this group was carefully reviewed, especially taxonomically.

Messrs. Davis, Schaeffer, Barber, Lutz and Bequaert discussed some of the questions raised, especially in regard to the retention of names of unrecognizable species, which may tend to falsify faunal lists.

Mr. Wright under the title "Notes on Pacific Coast Collecting" described a wagon journey made with Mr. Geo. Field along the Mexican boundary of southern California with its hardships, especially from thirst and cold night winds. He told of finding a half bushel of *Tegrodera erosa* in dried grass, of a black mass of *Canthon simplex* 12 inches in diameter by 4 inches thick among the leaves at the base of an oak tree, of the many rare Lepidoptera caught, of the rare Dytiscidæ and Buprestidæ found by following the small stream that flows through Devil's Canon as well as the many interesting personal episodes of such a trip, of which the desert sunrise had made one of the deepest impressions. Mr. Wright dwelt especially upon the large number of specimens obtainable in southern California, giving among other instances the picking of 265 *Lycaena melissa* from a small patch of grass and the total of 2,500 diurnals caught on the trip, besides over 1,000 Coleoptera. He spoke also of other interesting captures near San Diego, where he said they now

had a local list that included over 150 Geometridæ, 100 diurnals and at least 150 new species including microlepidoptera.

Mr. Leng read a paper on "Guides to the Literature on Coleoptera" which was discussed by Mr. Schaeffer and Dr. Bequaert, the latter regretting that no entomological review approached the complete character of the *Botanische Jahrbücher*.

Mr. Hall exhibited a fungus-killed caterpillar.

Mr. Davis alluded to Mr. Wright's approaching return to California and expressed the deep regret of himself and many other members that he would no longer be able to attend the meetings.

Mr. Wright said he should nevertheless retain his membership and endeavor to keep in touch with the friends he had made in New York.

Mr. Dow placed at the disposal of the members a box of specimens taken at Claremont, N. H.

MEETING OF OCTOBER 2.

A regular meeting of the New York Entomological Society was held on October 2, 1917, at 8:15 P. M., in the American Museum of Natural History, President Harry G. Barber in the chair, with 16 members and two visitors present, including Mr. Williamson, of Royal British Flying Corps.

The President called for summer experiences of members.

Mr. Hall said that with Mr. Watson he had made an automobile tour in July through Lakewood, Ocean City, Cape May, Wind Gap and Delaware Water Gap; and had also visited Nantucket, Marthas Vineyard and Gay Head, where he had met Mr. Jones. The principal object was to take *Satyrus maritima*, in which he had been successful, capturing 250 on Nantucket. Butterflies were scarce on the New Jersey trip.

Dr. Bequaert gave a preliminary account of the Cornell Biological Transcontinental Automobile Trip in which he participated. The party started from Ithaca with three automobiles and a trailer and covered about 6,000 miles through New York, Pennsylvania, Maryland, Virginia, North Carolina, South Carolina, Georgia, Alabama, Mississippi, Louisiana, Texas, New Mexico, Arizona and California, camping and collecting en route. He expressed his appreciation of the executive ability of Dr. J. Chester Bradley, who planned the trip and carried on the details of its management, and to the mechanical talent of Mr. H. H. Knight, which was at times needed in handling the cars, as well as to the congenial companionship of his fellow members in the party. The collecting in the wild country between Mobile and New Orleans, especially in the cypress (*Taxodium*) swamps near Jackson, Ala., and again in southern Mississippi, was very good. Several weeks were spent in Arizona near Tucson, Phoenix and Yuma with good results. Dr. Bequaert gave many amusing instances of the untoward incidents of the long journey and closed by expressing his admiration for San Diego, with its beautiful gardens and parks, including the Torrey Pine Park, where *Pinus torreyana* is carefully preserved. He mentioned also his meeting Dr. Van Duzee at Berkeley and

his gratification at finding how many types had escaped the San Francisco earthquake and fire.

Mr. Dickerson said his summer had been spent in nursery inspection work with Mr. Weiss. The abundance of plant lice in the early summer and of caterpillars later had been features of the season. He had also spent some time on Slide Mt. in the Big Indian Valley, Catskill Mts., finding good collecting and comfortable quarters at Joslin House, Oliveria, N. Y.

Mr. DeVyver said he had been occupied in making moving pictures to show life history of bag worm, tussock moth, etc., and offered to exhibit them at a future meeting.

Mr. Davis exhibited a bound volume of the entomological writings of the late John A. Grossbeck, outside of his work on mosquitoes; also a series of *Satyrus alope*, and contributed notes on *Canomyia ferruginea*, *Cicada hieroglyphica*, *Cicindela abdominalis*, *Holcaspis centricola* and *Rhodites gracilis*, the last having been collected by Mr. Woodruff. These will be printed in Miscellaneous Notes.

Mr. Burns exhibited 19 cicadas which he had obtained after four hours' labor in excavating a nest of *Sphecius speciosus* at Fort Wadsworth, Staten Island on August 18. The tunnel made by the wasp was about 2½ feet long and there were eleven cells, eight of which contained two cicadas each. The cicadas were *Tibicen linnei* and *sayi*, 16♀♀ and 3♂♂.

Mr. Watson exhibited the larva of *Acronycta funeralis* Grote & Robinson, found on *Prunus serotina* at Washington Heights, New York City, August 13, 1917. He said the season in his experience had been two weeks late and very poor for butterflies.

Mr. Mutchler had spent a part of his vacation at Bushnellville near Shandaken, with poor results, on account of rain.

Mr. Nicolay exhibited recent accessions in Californian Buprestidae and Cerambycidae received from Mr. Grinnell and spoke of his collecting trips to Lakehurst and Bulls Head with Mr. Woodruff, showing photographs.

Mr. Leng exhibited specimens of the Chilean *Ceroglossus darwini* received from Eduardo Varas Arangua and said that he had been too much occupied during the summer with work on the new Check List of Coleoptera for extensive field work.

Mr. Barber spoke of his visits to Virginia in August and to Yaphank, where he said Camp Upton would eventually come to within half a mile of Miss Weeks's house. He also reported satisfactory collecting.

MEETING OF OCTOBER 16.

A regular meeting of the New York Entomological Society was held at 8:15 P. M., October 16, 1917, in the American Museum of Natural History; President Harry G. Barber in the chair, with 20 members and three visitors present.

Dr. W. H. Wiegmann, of 436 East 5th St., was elected an active member.

The Secretary submitted a statement regarding the Permanent Fund, to be printed in the JOURNAL.

Mr. Woodruff moved that a special meeting of which notification should be sent through the Bulletin of the New York Academy of Sciences, be held October 30, 1917; and that the regular meeting of November 6 be omitted. The motion was carried.

Greetings to the members from Mr. Beyer were received through Mr. Sherman and from our former member, Charles R. Plunkett, through Mr. Davis.

Dr. Bequaert spoke of "Symbiotic Relations between Mites and Hymenoptera" illustrating his remarks, which will be printed in the JOURNAL, by specimens and blackboard sketches.

The subject was discussed by Dr. Lutz, Messrs. Olsen, Dow, Davis, Engelhardt, Richardson and Woodruff, especially in relation to nymphal forms only of the mites being known.

Mr. Barber gave an "Illustration by Specimens of the Synoptic Keys to the subfamilies, tribes and genera of Lygæidæ," referring to his own paper in *Psyche* and using also blackboard sketches.

Mr. Burns exhibited *Papilio cresphontes* and other rare butterflies from Staten Island, his data being printed in Miscellaneous Notes.

Mr. Engelhardt exhibited the larva of *Papilio cresphontes* found in Prospect Park, Brooklyn, on *Ruta graveolens*, a member of the Rue family, introduced from the Mediterranean region, and a previously unknown food plant for the species. Its indigenous food plants in this latitude are *Ptelea* and *Xanthoxylum*, and further south, *Citrus*.

Mr. Nicolay reported his recent visit to the National Museum and the extraordinary series of bred Euprestidæ and Crambicydæ shown him by Mr. Fisher. He exhibited also a box of flies collected this summer, among which Dr. Bequaert noted *Goniops chrysocoma*, Great Falls, Va., June 10, 1917, and *Lepidophora ægriiformis*, Boonton, N. J., September 3, 1917, as noteworthy captures.

Mr. Davis exhibited a box of grasshoppers and remarked upon their rapid spread, saying that in 1904 Mr. Woodruff had found *Conocephalus strictus* at Arrochar, Staten Island, on a dry hill where blue bent grass (*Andropogon virginicus*) grew. Since that time the grass has spread widely on Staten Island and the grasshopper has been found all over the island from St. George to Tottenville. *Mcianoplus scudderi* has likewise spread over the island in similar dry places.

Mr. Notman exhibited a box of Satyridæ from the Adirondacks and a box of Hemiptera that he had collected this summer for Mr. Barber.

Mr. Leng exhibited a box of *Cicindela repanda* and *C. 12-guttata* also collected by Mr. Notman in the Adirondacks this summer for the purpose of disproving by the differences in size, form and maculation, constant in a large series, the varietal rank erroneously assigned the former in Genera Insectorum.

Mr. Davis spoke of the Cicadas and Orthoptera collected for him by Mr. Notman and Dr. Bequaert of the Hymenoptera; Mr. Dow remarked that the

6,000 specimens caught, marked and labelled by Mr. Notman this summer was an unusual record for any collector.

Mr. Richardson spoke of the great numbers of *Cynthia* larvæ on *Ailanthus* along the Harlem River during the past summer.

Mr. Leng called attention to an article in *Science*, October 2, 1917, on the resistance to starvation of Dermestid larvæ and the request for any amount of living larvæ, pupæ or adults by the author, J. E. Wodschalek, Moscow, Idaho.

MEETING OF OCTOBER 30.

A special meeting of the New York Entomological Society was held at 8:15 P. M., October 30, 1917, in the American Museum of Natural History, Vice-President Lewis B. Woodruff in the chair, with 17 members and one visitor, Thos. E. Snyder, of the Bureau of Entomology, U. S. Dept. of Agriculture, present.

Mr. Wunder's album of the Society's collection of photographs of entomologists in action was shown by Mr. Davis and additions solicited.

Mr. Dickerson read a paper on *Popilia japonica*, Newm., to be printed in the *Journal of Economic Entomology*, and exhibited specimens prepared by Mr. Weiss, of this Japanese beetle, found in a nursery in New Jersey and believed to have been introduced with iris roots. Its work on grape leaves was shown and the extent of its dispersal, not exceeding so far a few hundred feet, was discussed.

Mr. Weiss supplementing these remarks, said the federal government had taken up the matter and an effort would be made in conjunction with New Jersey authorities to exterminate the beetle.

Mr. Olsen read a paper "Notes on *Draculacephala inscripta* Van Duzee," a rare Jassid of which he had records from Staten Island, New Jersey, Georgia, Florida, Tennessee and Texas. His remarks will be printed in the JOURNAL.

Mr. Davis on request described the occurrence of the insect under electric lights at Fort Myers, Fla.

Mr. Leng read a paper on West Indian Fireflies, which will be printed in the Museum Bulletin and exhibited the collection assembled by Mr. Mutchler from Museum and borrowed material. It was discussed by Dr. Lutz, Mr. Davis, Mr. Dow and Dr. Bequaert, who described the Lampyridæ of the Congo.

Mr. Woodruff exhibited a rare moth *Hyperaschra georgica* found in beating oak at Lakehurst, June 17.

Mr. Olsen exhibited *Limnitis ursula* form *albofasciata* taken in his garden at Maspeth, L. I., September 8.

Mr. Davis exhibited *Cuterebra fontinella* taken at Oliveria, Ulster Co., N. Y., by Mr. Shoemaker, July 1, and mentioned previous records, discussing the habits of these flies.

Dr. Bequaert called attention to the absence of any complete life history, stating that the method of oviposition remains unknown, as well as the differences between the larvæ. In no case has the larva been reared so as to connect it with described adults.

Dr. Lutz spoke of the Bumble Bees collected by Mr. Notman in the Adirondacks, calling attention to the northern species, rare in New York, and to two species of the rare *Psithrus* (or *Apathus*), whose cuckoo habits have been commemorated in verse by Dr. Howard in the "Insect Book." He pointed out that males predominated because the collection had been made towards the end of the season.

Dr. Bequaert exhibited the nest of a mud wasp, probably *Odynerus* sp. given to Mr. Olsen which had been made about a piece of wire projecting from a cement wall.

Mr. Davis remarked that such nests were often made year after year near the same locality.

Mr. Snyder briefly described his trip through the Everglades of Florida, during which he travelled on foot and by canoe from Homestead to Cape Sable, principally to collect termites. Among many interesting episodes he mentioned an extraordinary swarm of horseflies at 4:25 A. M., just before dawn, accompanied by a buzzing noise that sounded like many swarms of bees. The injury in southern Florida to pines by the west Indian *Chrysobothris impressa* was also commented on. Continuing his journey through central Texas, Arizona, California, Oregon, always in search of Termites he found many things of interest, among which he mentioned *Cyllene crinicornis*, chewing mesquite into sawdust in Texas and *Sinoxylon* boring into lead cables in California. In Oregon the trip to Crater Lake in June was made on snow shoes. The return journey was made through Nevada, Utah and Kansas and great collections of Termites was the chief result.

INDEX TO NAMES OF INSECTS AND PLANTS IN VOLUME XXV.

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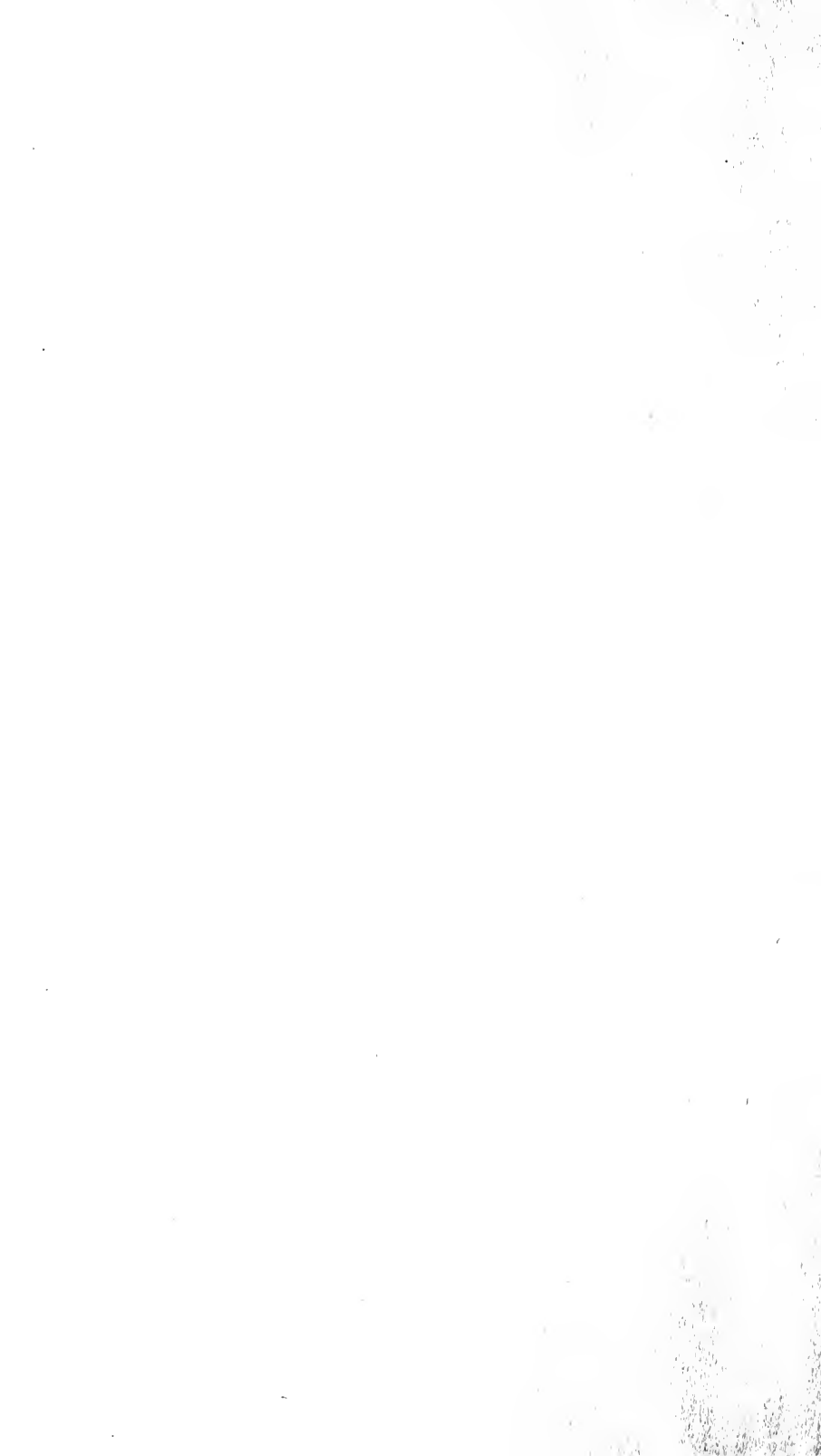
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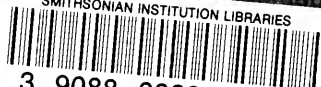
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